EUROPEAN COMMISSION

Community research

April 2008

The European Foresight Monitoring Network

Collection of EFMN Briefs
Part 1

CASE STUDIES

Interested in European research?

Research*eu is our monthly magazine keeping you in touch with main developments (results, programmes, events, etc.). It is available in English, French, German and Spanish. A free sample copy or free subscription can be obtained from:

European Commission
Directorate-General for Research
Communication Unit
B-1049 Brussels
Fax (32-2) 29-58220
E-mail: research-eu@ec.europa.eu
Internet: http://ec.europa.eu/research/research-eu

Europe Direct is a service to help you find answers to your questions about the European Union

New freephone number (*):

00 800 6 7 8 9 10 11

*Certain mobile telephone operators do not allow access to 00800 numbers or may charge for these calls. In certain cases, these calls may be chargeable from telephone boxes or hotels.

EUROPEAN COMMISSION

Directorate-General for Research
Directorate L – Science, economy and society
Unit L2 – Research in the economic, social sciences and humanities – Prospective

Contact:
Scientific Officer: Marie-Christine Brichard (marie-christine.brichard@ec.europa.eu)

European Commission
B-1049 Brussels

EUROPEAN COMMISSION

The European Foresight Monitoring Network

Collection of EFMN Briefs - Part 1

2008

Directorate-General for Research
Cooperation

EU 23095 EN

This volume was edited by the following members of the EFMN team:

Susanne Giesecke, Austrian Research Centers GmbH – ARC, systems research, Vienna, Austria
Patrick Crehan, CKA – Crehan, Kusano & Associates, Brussels, Belgium
Stephan Elkins, Social Scientific Translation and Editing Services, Marburg, Germany

LEGAL NOTICE

A great deal of additional information on the European Union is available on the Internet.
It can be accessed through the Europa server (http://europa.eu).

Cataloguing data can be found at the end of this publication.

Luxembourg: Office for Official Publications of the European Communities, 2008

ISBN 978-92-79-07448-6

Printed in Belgium

PRINTED ON WHITE CHLORINE-FREE PAPER

Table of Contents

Foreword

Foresight identifies future research and innovation priorities going within and beyond the Lisbon strategy and contributes to building a strong European Research Area. It helps in the early identification of emerging issues that could have far-reaching implications for European Science and Technology in the long run. It contributes to the analysis of changes in the global research system and their possible implications for European research policy.

The Foresight Monitoring Network (EFMN) is a Europe-wide network inspired and financed by the European Commission in the framework of the Foresight Knowledge Sharing Platform implemented under the Research Framework Programme. The EFMN initiative identifies the big scientific, technological and social challenges of tomorrow, contributing thus to the main priorities of the socio-economic sciences and humanities research.

Through a continuous monitoring and mapping of ongoing and emerging Foresight activities conducted not only in Europe, but also in other regions of the world, the EFMN project identifies “hot topics” noteworthy for their novelty or importance and contributes to the dissemination of this relevant information through the production of short foresight policy briefs. It covers countries as varied as the EU Member States, Japan, China and Korea, the US, Canada and Brazil. Those briefs that were written between 2004 and 2007 summarize the results of recently terminated or on-going foresight activities dealing with crucial topics such as the hydrogen economy, the knowledge-based development of rural economies or the sustainable exploitation of marine resources.

With its mapping and analysis of 1000 Foresight exercises revealing key questions for S&T in the period up to 2020, EFMN work also contributed to the 2007 report “Europe in the global research landscape” by providing indicators on the future societal demand for science and technologies. EFMN identified broad areas of future concern in Science and Technology for Europe and the world, such as the growing concern in Europe for environmental technologies, energy, Information and Communications Technology as well as the growing interest in public health care.

The present collection of the first 120 EFMN foresight briefs is a very useful information and dissemination tool addressed not only to the Foresight community but also to policy-makers. Harnessing the knowledge coming out from our funded projects to inform policy decision making has indeed to be a major priority if the European Research Area is to become a reality and Europe is to become the most competitive knowledge-based economy in the world. The aim of this publication is to allow a better use of the results of foresight exercises by bringing information on crucial societal topics to the attention of policy-makers.

Jean-Michel Baer
Director

Introduction

EFMN Publication for the first 120 Briefs

The European Foresight Monitoring Network

The European Foresight Monitoring Network (EFMN) is an initiative inspired and financed by the European Commission and was started in 2004 as a service to foresight practitioners and policy makers in Europe and beyond. Responsible for the operation of EFMN are the following European organisations: TNO (NL), PREST (UK), CKA (B), VDITZ (D), and ARC (A).

The EUROPEAN FORESIGHT MONITORING NETWORK is part of the Foresight Knowledge Sharing Platform – a coordinated series of European Commission initiatives to support the professional development of foresight practitioners in Europe. It forms an important part of a strategy to develop the European Research Area and contains three main lines of action:

1. Monitor and disseminate information about foresight developments in Europe and the rest of the world,
2. Promote mutual learning among professionals interested in foresight related issues,
3. Conduct studies on key issues for EU research and innovation policy that provide input to RTD and innovation related foresight activities in Europe.

Among the many definitions that try to specify what foresight is, the EFMN has chosen the following one to operate the network:

FORESIGHT is a participative approach to creating shared long-term visions that inform short-term decision making processes. It is used by policy professionals who work at the level of the nation, the region or municipality, at the level of the research system, the industry sector, cluster or stronghold and at the level of the supply chain or production system. FORESIGHT mobilizes actors and creates broadly based support for policies that are developed in this way.

The EFMN approach is based on the continuous process of monitoring and collecting data on foresight exercises conducted not only in Europe, but in other regions of the world as well. This information is collected using experts within the international foresight community. The information gathered provides the basic raw material for the following tasks:

- Production of briefs: These are short 4-page descriptions of interesting, recent, or ongoing foresight exercises and forward looking studies. The present publication comprises the first 120 EFMN briefs that were written between 2004 and 2007.
- Mapping: In addition to simply monitoring on-going activities, we compile detailed data on these activities and publish an annual report that analyzes trends and developments in Europe and other regions of the world.
- Issues analysis: This analysis allows us to identify emerging issues that may be of importance to the research community in Europe. The intention is to highlight emerging issues rather than established and easily recognizable trends. All of this is summarized in an annual report.
- Dissemination of information: The EFMN portal and its mailing lists located at www.efmn.eu provide the main means of dissemination. It is updated continuously as briefs are produced and as new initiatives are identified. It features the individual correspondents and provides links to the main European Commission foresight related initiatives, as well as a calendar and a distribution list that already has about 3,000 members.

The Network of Correspondents

The EFMN relies on a high level of participation of foresight experts from Europe and the rest of the world. Although the EFMN team provides a critical mass to ensure continuity and momentum, it is important that other foresight experts and policymakers are involved in the collection of data.

We rely on the active participation of correspondents who can contribute to the identification of foresight exercises, the mapping and the production of briefs. All of theses contributions support the network in providing information on foresight events, identifying new important emerging issues related to societal and economic implications to help create an innovative European Research Area.

The network represents more than 180 correspondents who themselves are often actively involved in the implementation of specific foresight exercises and have taken the opportunity to contribute to the building of a database. It is open to anyone else interesting in making a contribution.

The Purpose of the Foresight Briefs

Foresight briefs provide our readers with concise, up-to-date overview information on the motivations, the process and the results of recent or ongoing foresight exercises. The EFMN platform serves as a 'showroom' for the most remarkable foresight processes whose initiators are willing to share information about their methods applied, participants, addresses, outcomes and policy implications with a wider audience. The unique activity of the European Foresight Monitoring Network offers foresight practitioners an opportunity to make their activities more widely known in the European foresight community and beyond. As foresight is more and more becoming a tool for policy makers and corporate decision makers the EFMN briefs prove to be a valuable source of information on subjects that are discussed in world wide foresight activities as well as on future policy options to support socially sound and economically feasible solutions. The clientele of EFMN briefs – both authors and readers – comprises a wide spectrum of foresight practitioners, interested stakeholders and stakeholder organisations (e.g. industrial organisations, NGOs), researchers and strategists in industry and academic organisations, policy makers and public administrators at European, national, regional and local levels.

The success of the foresight briefs thus depends on the willingness of the foresight community to make interesting contributions to the growing list of briefs and thus jointly build up a rich content-driven information base on the most recent foresight activities not only in Europe but in other regions of the world.

The Content of the Foresight Briefs

Since its inception in late 2004, the number of briefs written by independent correspondents and members of the EFMN core team published on the EFMN web site has risen steadily up to 120 to this date. The majority of briefs are authored by foresight practitioners from the EU27 covering activities in the European Research Area. However, a considerable number of briefs reports on emerging trends worldwide, and touch regions beyond Europe: North America, Latin America, Asia, the Pacific region and Africa. While many briefs give an overview on national foresight activities, specific topics are addressed as well. It is noteworthy that technological developments are more and more regarded within their societal contexts, considering the social, economic and ecological impacts they might foster. In this sense, foresight becomes a policy tools that helps decision makers chart directions of technological developments that meet social needs and take people's concerns serious. Consequently, the briefs presented in this volume cover technological areas such as ICT, life science, nanotechnology, new materials etc. as well as societal issues, e.g. demographic change, the knowledge society or education.

In addition to these thematic trends, the briefs present also a good overview on a broad variety of methodological approaches applied in the various foresight exercises. Whilst in the past foresight and its predecessor tools (e.g. forecast) were associated with the top-down approach, recent foresight initiative have some bottom-up approaches as well, trusting the benefits of participatory activities. Given the recent nature of most foresight initiatives that are presented in this volume, it is hard to assess the policy implications and outcomes that are associated with these initiatives. Though most authors attempted to give an outlook on these aspects more timely distance is needed to report on the political effects and the realization of the policy recommendations that are formulated in the specific foresight briefs.

The briefs published here reflect the order of the appearance on the EFMN homepage. No ranking is associated with the numbering. The three indices at the end of this volume are meant to give the readers a better orientation in search of specific subjects, regions or authors.

As the EFMN core team we would like to use this occasion to thank the European Commission as well as the many correspondents for their valuable contributions that made this publication of this volume of briefs possible. We hope this book will stimulate future foresight activities and an enlargement of the European Foresight Monitoring Network.

Futur – The German Research Dialogue

Title	Futur – The German Research Dialogue (Futur – der Deutsche Forschungsdialog)
Author	Susanne Giesecke of ARC Systems Research/ Susanne.Giesecke@arcs.ac.at
Sponsors:	The Federal Ministry of Education and Research - Bundesminsterium für Bildung und Forschung
Type:	National foresight process - covering various fields of S&T as well as socio-economic and socio-cultural trends
Organizer:	IFOK (Institut für Organisation und Kommunikation) in co-operation with Fraunhofer ISI, IZT, VDI/VDE-IT and Pixelpark
Duration:	2001-2005 — Budget: € 2-3M per year — Time Horizon: 2020

Identifying the Future Needs of German Society

Futur - the German Research Dialogue is designed to assess the future needs and demands for science and technology and to consider their broader implications for the socio-economic and cultural development of the country. The intention is to include a large number and broad variety of participants in the exercise representing not only science and technology but also the various stakeholders of German society. So far about 1250 experts have been involved.

A New Approach to R&D Agenda Setting

A major motivation for the German Research Dialogue is the search for new topics to be funded by the Federal Ministry of Education and Research. The traditional process of generating funding priorities and setting agendas essentially covers traditional or established disciplines and does not provide opportunities to pursue truly innovative and new topics. A new approach is therefore required to bring together very different kinds of expert to produce unusual perspectives and new ideas.
The main objective is to identify new priorities for future R&D funding activities that would:

- Respond to relevant societal needs and demands,
- Bring together different fields in an interdisciplinary approach,
- Support the competitiveness of the German economy and
- Be innovative.

The identified priorities did not necessarily have to be technology related but they had to fit within the range of responsibilities of the Federal Ministry of Education and Research.

Public Participation

The German Research Dialogue has a very broad participatory approach. It is still ongoing and so far it has gone through two successive rounds of research dialogue. A third round is under preparation. At the beginning of each new round a large set of ideas and possible subjects for future research is introduced to a large number of experts representing various scientific and societal fields – experts from research organisations, NGOs, education, culture and industry.

In the first round these ideas came from the Futur consortium. In subsequent rounds new ideas are generated by online discussions involving members of the Futur community. Some experts are nominated by the consortium or by the ministry. However anyone interested in contributing can apply to participate in the activities that make up the research dialogue, and become members of the Futur Community.

To get started participants gather together to deliberate in open conferences or in similar but not strictly structured events. The subjects that seem most interesting are discussed, selected, and condensed.

In subsequent events - spread over the following year - the topics are filtered once again and focused by groups of selected experts representing different disciplines to cover as many aspects as necessary.

This entire process is supported by creativity workshops and future workshops (Zukunftswerkstätten).

In each round of the research dialogue, representatives of the ministry are included in the working groups to make sure that the results can be translated into policy activities that fall within the competence of the ministry. The selection round is finalized by a voting process. Various approaches are used including online-voting among the actors involved. In the last round of the research dialogue somewhere between 12 and 20 subjects compete against each other until two to four priorities are identified and presented to the ministry for policy implementation.

Identification of Lead Visions

Futur - The German Research Dialogue has now entered its third round. Four 'lead visions' have been formulated and agreed upon for policy action by the ministry in charge. These topics link socio-economic and technological trends in a complex and inter-dependent way. The technology and socio-economic dimension of these visions cannot be strictly separated from each other.

These Lead Visions and further topics currently under discussion by expert focus groups in cooperation with the ministry are briefly described in the following sections. They correspond to socio-economic or cultural trends and trend breaks identified in the course of the research dialogue.

Socio-Economic Challenges

'Creating Open Access to Tomorrow's World of Learning' is a lead vision hinting at a society where every individual is capable and willing to continue learning throughout life. It envisages a society where each member is guaranteed access to his/her individual worlds of learning, adaptable to personal needs, comprising institutional as well as human resources. Other aspects of this lead vision are questions of certification of education and qualification as well as the networking of locations offering education.

'Healthy and Vital throughout Life by Prevention' is a lead vision that reflects the aging society in Germany – not only in order to save medical costs. The goal to stay healthy by preventive activities rather than mending health problems by conventional medicine is to be attained by means of health-conscious behaviour by each individual. The focus is thus put on research and development to create the conditions for efficient prevention in the future.

'Quality of Life through Healthy Nutrition' addresses the question how a balanced diet can increase human health. The topic has recently become a lead vision and touches issues such as sustainable supply chain of nutrition, transfer from nutrition science into every-day practice, and the role of the food sector in the innovation system.

'Water as resource – visions for a guaranteed supply and access for all in the 21st Century' is not a lead vision yet but one of the topics presently discussed for becoming a research priority. This theme is going to deal with new technologies for the processing, distribution, use, regeneration and substitution of water and will be coupled with new concepts of water management for contributing to a sustainable and efficient use of water. The issue will be combined with the underlying thematic of complexity management.

Technological Trends

'Understanding thought processes' was identified as a lead vision for the exploration of how the brain manages information processing, cognition and creativity. This topic is coupled with concerns on how teaching and learning strategies can be more efficient. One anticipated area of application is the development of medical neuro-prostheses that could give physically challenged people a new perspective. A new and comprehensive approach that was to be pursued with the lead vision would be the experimental combination of computer simulation and mathematical models as it is undertaken in computational neuroscience.

'Living in a Networked World: Individual and Secure' is the title of the lead vision that wants to create a more personal access to the ongoing and accelerating networking of information technologies. It is thus oriented at adapting digital networks according to the user by acknowledging his/her autonomy and individual needs. Besides, the networked world is supposed to serve as a reliable infrastructure, allowing a bi-directional flow of information any time, any place and at any situation. Even though the networks and technologies should be individualized, the social context of the individual always has to be taken into consideration to prevent social isolation.

'Bionics: Ideas from Nature for intelligent housing' is based on the assumption that by analysing and copying construction principles as they are applied by nature housing can be adjusted and designed according to the changing demands and needs of inhabitants. This strategy is supposed to increase the quality of living and at the same time decreasing the energy consumption. Principles of sustainability are to be combined with user friendliness, aesthetics and marketability.

'Biological engineering' is a subject for a possible future lead vision aiming to use biological systems, biological engineering and engineering sciences. The expectation is that this combination would open up new possibilities for the systemic technical use of biological systems.

Bottom-up Process

The German Research Dialogue Futur was designed as a bottom up process. That is to say that the priorities were formulated over the course of a range of conferences, workshops, focus group meeting as well as online-voting. The direction and results were open. What makes this process and its results so important to German society and to the Ministry of Education and Research is the consensus it achieved over the research topics that should be addressed through funding today in order to have a comfortable life beyond the year 2020 and in order to maintain a sustainable standard of living for generations to come.

From Participation to Implementation

Futur – The German Research Dialogue is a process initiated and funded by the Federal Ministry of Education and Research and it is primarily interested in the formulation of new research priorities. The assessment of future developments falls into the domain of the ministry. Futur does not however touch upon policy issues that fall within the jurisdiction of other ministries or political actors.

For the first round of Futur no additional money was available for funding programmes that would act upon the Lead Visions by supporting research intended to contribute to their development. Nevertheless funding is available through existing R&D programmes to pursue these issues.

All issues identified as future R&D priorities by the German Research Dialogue address expected opportunities and challenges as well as obstacles to progress. Each issue raised requires an individually designed solution. It is too early to present results of the projects that have only recently started and most of these will run for a couple of years.

Redefining Funding Programmes

The Lead Visions have helped to identify a number of priorities for R&D policy makers in Germany. Some of these are being addressed on the basis of projects funded in existing or new funding programmes.
The most prominent ones which are already being acted upon are as follows:

- Among the projects with regard to the lead vision 'Living in a Networked World' the ministry initiated 'Verisoft' to support the development of IT security standards. The project's goal is to achieve the uniform and formal verification of computer systems and to mathematically prove the correctness of the systems used. This research will be applied to the automotive industry, security technology as well as to the medical sector.
- Another project initiated was 'SmartWeb' in order to develop software that helps the web to understand the content of entire sentences.
- In response to the lead vision 'Understanding Thought Processes' the ministry set up a 'National Network on Computational Neuroscience' consisting of local centres reinforced through the concentration and expansion of already existing capacities.
- An ongoing medical research programme took up the incentives given by 'Healthy and Vital throughout Life by Prevention'. Accordingly prevention research projects will develop new concepts and instruments against the diseases of civilisation.

Other Lead Visions have not yet been transferred into funding programmes.

The lead visions and any additional activities that might derive from the process as a whole, represent a consensus achieved by the actors involved – both the experts and the representatives from the ministry.

Issues, risks and controversial debates were addressed in the focus groups that helped to formulate the Lead Visions. This does not mean that all critical factors have been solved. On the contrary, this should be a part of the programmes funded in response to and intended to address the Lead Vision.

Sources and References

- http://www.futur.de

Bundesministerium für Bildung und Forschung (2003): Futur – der deutsche Forschungsdialog. Eine erste Bilanz. Bonn

Swedish Technology Foresight 2004

Title	Teknisk Framsyn		
Author	Sami Mahroum of ARC Systems Research / sami@mahroum.net		
Sponsors:	Industrifonden The Royal Swedish Academy of Sciences & Engineering - IVA The Knowledge Foundation - KK-stiftelsen Labour Organization/Union - LO The Swedish Business Development Agency - NUTEK The Confederation of Swedish Enterprise - Svenskt Näringsliv The Science Council - Vetenskapsrådet The Swedish Agency for Innovation Systems - VINNOVA		
Type:	National Foresight process – covering various fields of S&T as well as socio-economic and cultural trends		
Organizer:	Teknisk Framsyn		
Duration:	2003-2004	Budget: € 1.7 M	Time Horizon: 2020-2025

Purpose

Teknisk Framsyn's second foresight study aimed to identify the preconditions for sustained technological progress and economic growth for Sweden over a 15-20 year period to 2025. With its intention of inspiring the coming generation of decision-makers who will shape Sweden's future, the project was directed at the private sector as well as government, public sector policies and organizations.

Sweden's Future from a Global Perspective

Teknisk Framsyn's second foresight exercise was launched as part of a national effort for Choosing Strategies for Sweden. This arose from the concern that not all organizations in Sweden possessed the capability or the capacity to engage in future-guided activities. The study followed a first foresight exercise, completed in 2000, which resulted in a report called The Foresighted Society.

The point of departure was the recognition that Sweden needed to consider its future from a global perspective. Within this context, the project aimed to:

Strengthen future-oriented and guided activities within organizations in both private and non-private sectors.
Identify competence areas with strong growth and innovation potential for Sweden economically, socially and ecologically.

Engender a basis and create processes for priority-setting for Sweden to further develop knowledge and competence areas in the national innovation system.

This foresight project was officially described as an 'update' of the previous technology foresight programme. The project was led by a management board, a director, and a steering group all representing the various organisations that stand behind it. The daily operations of the project were directed by a part-time project leader and five panel managers (supported by project assistants) representing the organisations in the management. Project managers were aided by a Methodology Group that acted as a scientific advisory board. In addition, an Information Group was formed and a web space created to provide a forum for both internal and external information and communication about the project.

The project was conducted through a combination of panel discussions, interviews and hearings and open forums. A number of panels were set up around the following themes: Other National Foresight Programmes, Inspiration for Innovation, Upgrading (Swedish) Foresight. The latter consisted of seven focused projects and panels dealing with Technological Environments, tasked with updating the findings from the first foresight study. These were: Information Technology, Production Systems, Materials, Infrastructure for a Borderless Europe, Biological Sciences, Health, and Education. In forming these panels, there was emphasis on ensuring a diversity of backgrounds. Furthermore, a final Synthesis Panel, comprising 12 experts of varied backgrounds, brought together all the project's findings into a synthesis report, Choosing Strategies for Sweden. In addition, this Synthesis Panel broadened the perspective of the discussion to include economic and social preconditions – such as the innovation climate, tax system, institutions and regulations.

Harnessing Technology for Sweden's Future

The panels identified more than 500 fields of technology or knowledge considered to be potentially important for Sweden's future. Of these, 100 fields were selected and assessed from an overall supply and demand perspective, i.e. how developed was the technology and how much demand was there for it. The panels took into account issues such as the proximity of a particular technology to the market (e.g. fuel cells), and the breadth of demand, i.e. in how many sectors and processes could a technology or knowledge conceivably be used, now or in the future?

Driving Forces

Sweden faces a number of driving forces that will be crucial to its long-term development and prosperity. These driving forces can be summarized as follows:

- Living in a **borderless world.** Increasing globalization in production, trade, products, travel and lifestyles will continue to change the fundamental preconditions of Sweden's development. Furthermore increased contact between people posits new challenges, for example the breakout of so-called 'Severe Acute Respiratory Syndrome' (SARS) in 2003. Aside from human suffering, this epidemic had severe economic consequences for many countries during 2003. Counter-forces to globalization will also increase, and terrorism will create global vulnerability.
- The **knowledge Society** is becoming more prevalent. More and more, Sweden is leaving behind the old industrial society and entering a society based more on information, knowledge and expertise. At the national, regional and local level, as in each individual company it is becoming vital to develop the capacity to use knowledge in various ways. Challenges are becoming more and more cross-technological, thus requiring different sets of training for the workforce of the future.
- **Individualization** is on the rise, while new groups are being formed and values are changing. New values based on strong individualization, combined with clear group affiliations are replacing old ones. Individualization, new groups and changing values open up new opportunities for new products and services and provide a strong potential for economic growth.
- Technology is **reshaping** society, and society is reshaping technology. In particular, developments in information technology (IT) and biotechnology will greatly change how people live. The digital revolution, with its new communications and information technology, has changed society and its way of living. The effects of the new biology will probably be equally great over time. There will be a greater need for human resources capable of adopting and adapting new technology in the economy and society in general.
- **Complexity** is leading to new demands. Ever-larger and more complex systems are being built (e.g. safety systems in cars, air-traffic systems, etc.), which means greater vulnerability to operational disruptions, sabotage and global spread of infections. These systems are extra complex precisely because they are socio-technological rather than merely technological.
- Global **climate change** is deepening, and the long-term exhaustion of non-renewable energy sources will create new conditions and challenges. The prevention of climatic change will become more and more important as a steering factor and boundary condition. Climatic issues are especially linked with energy production, energy conservation and energy policy in general. Climate change poses a severe threat to the infrastructure and lifestyle. At the same time, it serves as a driving force for technological development and a potential for development of products and systems to reduce and manage the impact of humans on climate.

Sweden's Technological Edge

Over 500 fields of technology and knowledge were assessed from a supply and demand perspective. The supply perspective (path breaking, maturity of a technology) describes what technology and knowledge can contribute. While the demand perspective (markets and needs) describes what society can be regarded as needing or what can be sold in a market. The project analyzed the preconditions for fields of technology and knowledge in Sweden according to criteria such as publication of scientific articles, Swedish patents, and current research priorities and resource investments. The top 100 fields in which Sweden had the best preconditions were then categorized within 11 areas as outlined in the Box below.

- Safer/more secure complex systems
- Mechanical systems and structures
- nteractive technology
- Functional materials
- Environmental and life cycle technology
- Mobile energy supply
- Fixed energy systems
- Safety, security and protection
- Sustainable food production
- Accessible IT
- Health care technology

The project discussed four innovation strategies that were intended in various ways to offset the shortcomings of today's innovation systems. This is reflected in Figure 1 where the four strategies are positioned with respect to their focus on different phases of the innovation process and with respect to the main actors who need to provide inputs to drive innovation in these strategies.

Whether a market exists for a particular technology or not is also an important dimension that influences the choice of strategy required to develop this technology further. Both strategies 1 ('Dare to Invest') and 2 ('Broad-based effort') aim at advancing new and path-breaking technologies. Whereas Strategy 1 focuses on specific applications in existing markets, Strategy 2 is geared towards broad applications in future markets. Similarly strategies 3 ('Just do it') and 4 ('The train is leaving the station') are required for existing technologies that are yet to be developed locally. Strategy 4 is compatible with an orientation towards a broad spectrum of applications in future markets; specific applications in existing markets are addressed by Strategy 3. The 100 fields of technology and knowledge that were selected by the panels were all placed in one of theses areas and correspond to an effective innovation strategy.

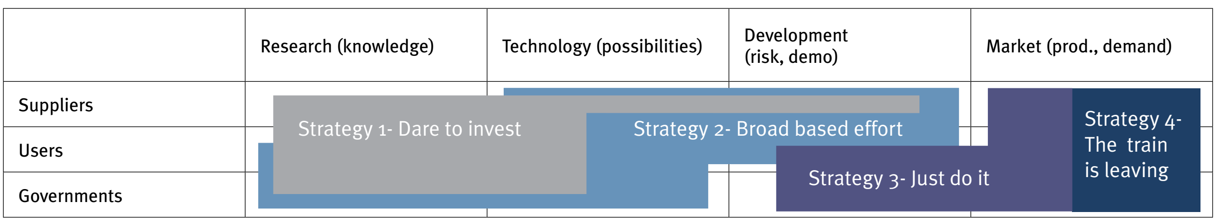
Daring to be Different

In setting out its vision for Sweden in the 21st century, the project presented the following six multifaceted and complex strategic choices:

- Swedes must see the opportunities of an enlarged world, not just the threats. To take advantage of the opportunities of globalization, Sweden must establish clear specializations. Sweden must build alliances with emerging markets, internationalize its educational system and actively pursue those issues that it believes to be the most important in the global arena.
- Sweden must dare to prioritize and focus. For a small, export-dependent nation like Sweden, it is impossible to be competitive in all fields. Sweden thus needs to concentrate its resources on strategic fields of activity. It needs to focus and specialize, both geographically and in terms of activities. For instance, Sweden should focus on businesses with high value-added, on expanding its production-related service sector (e.g. design, marketing, etc.), and on niches in specific fields of application where Sweden has the potential to build up and maintain in-depth expertise (e.g. complex systems, and high product customization).
- Sweden must concentrate its resources on investments and projects for the future. Swedish national infrastructure, which was largely built during the 1950s, 60s and 70s, is beginning to wear out and needs extensive maintenance. Swedes must ponder the implications of having roads, rail systems and cities that were built for the requirements and needs of the industrial society. What will be the communications, residential and living space needs in the future? Sweden should seriously regard the digital communications (broadband) network and the educational system as infrastructure that is as important as, or more important than, traditional concepts of infrastructure such as railroads. Extensive, high-quality infrastructure for digital communications is an important precondition for positive growth in nearly all areas of Swedish society.
- Sweden must modernize public sector commitments. Swedes must intensify the discussion and dare to make decisions on what services and what level of service should be offered in the future by the public sector, and what must be provided and paid for by individuals, especially in health and education.
- Sweden must become better at utilizing, evaluating and allowing room for the skills, creativity and commitment of every individual. Sweden must create optimism and a broad sense of participation of individuals in society. There must be clear leadership and opportunities for work, developing sound and healthy work organizations, taking advantage of diversity, ensuring the efficient exercise of government authority and creating a system of transfer payments and taxation that encourages studies and work. Sweden has to encourage innovative, knowledge-intensive operations, entrepreneurship, risk-taking and investments. Such activities must be allowed to be profitable for those who are prepared to engage in them.
- Sweden must take active steps to bring about a sustainable society. Swedes must develop new ways of converting and using energy so they can work, live and travel comfortably without destroying the environment. They need to redouble our efforts to develop sustainable products in more fields. Swedes must also intensify the task of creating intelligent rule systems and incentives in order to influence developments, both nationally and internationally.

Sources and References

- http://www.tekniskframsyn.nu
- Teknisk Framsyn (2004): Choosing Strategies for Sweden. A synthesis report from Swedish Technology Foresight, Stockholm
- Teknisk Framsyn (2004): Inspiration for Innovation – Swedish Technology Foresight 2004, Stockholm



Milanese SME Internationalization 2012

Authors:	Verena Hübner of ARC Systems Research/ Verena.Huebner@arcs.ac.at		
Sponsors:	Provincia di Milano MIUR (Ministry of Instruction, University, Research)		
Type:	A regional foresight focused on the socio-economic system of the Province of Milan and covering all local industrial systems		
Organizer:	Fondazione Rosselli		
Duration:	Sep 2002 to April 2004	Budget: Approximately € 150 000	Time Horizon: 10 Years

Purpose

The purpose of the initiative was to develop a vision and to achieve consensus among local stakeholders on the internationalization processes acting upon the socio-economic systems of the province of Milan to understand how Milanese SMEs were coping with the challenges of internationalization and EU enlargement and to assist local government bodies with their policy related priority-setting.

Context, Objectives & Approach

The Context of the Exercise

This foresight exercise was initiated by the head of the Department of European and International Co-operation of the Provincia di Milano, who recognized the need for a regional strategy and a common vision in order to harness the internationalization processes at work in the local economy. The motivation for this came from the observation that local industry in general and SMEs in particular, did not fully exploit the opportunities offered by the process of globalisation and more specifically by EU enlargement.

The Main Objectives

The exercise was intended to make regional stakeholders aware of the consequences of globalisation and enlargement for Milan's economy. The intention was to point out and raise awareness of the need for further internationalization of local industry and to prompt decision makers to take action.

Methodological Approach

A task-force composed of researchers from the Fondazione Rosselli was responsible for carrying out the project. A steering group known as the 'Comitato di Riferimento' was set up in order to establish and maintain contact with important local stakeholders. Twelve members represented the main sectors of the local socio-economic system. A panel composed of 19 experts representing the main areas of the socio-economic and industrial system of Milan came together in three workshops in order to elaborate on the scenarios.

The themes that were analyzed involved many interrelated processes with many variables and a high degree of uncertainty. Due to this complexity it was envisaged to carry out the foresight exercise in a step-by-step sequence, involving experts and stakeholders in order to identify relevant processes and critical drivers, allow the building of scenarios and provide the Provincia di Milano with guidelines for policies suitable at implementing measures that would favour the emergence of the most attractive and feasible scenarios for the region.

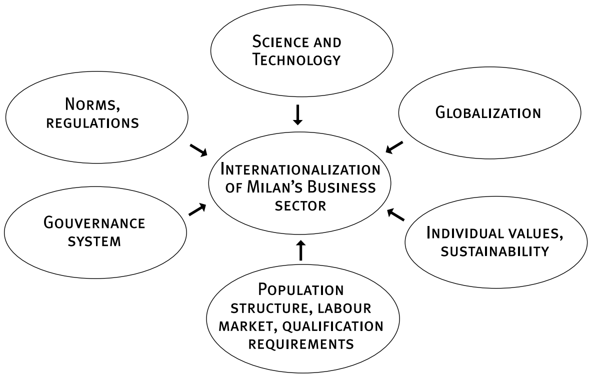
The following five project-phases can be identified:

- Description of the area's economic system focusing on the role of manufacturing and SMEs.
- Definition of a conceptual model that links the evaluation of the Milan area's industrial system with critical factors concerning the structure and organisation of the manufacturing industry, the governance system at different territorial levels, and the behaviour of individuals and society. The six main areas influencing internationalization are sketched out in the diagram.
- Analysis of possible evolution paths of four important sectors in the Milan area's manufacturing industry:
  - Software,
  - Machine tools,
  - Furniture,
  - Clothes,
- Design of possible scenarios of the development of industry in the Milan area.
- Elaboration of policy guidelines for the Milan Province based on specific preferred scenarios.

The scenario-workshop method was chosen because it supported wide participation of, and the development of a shared vision with, the main regional stakeholders. The project was supported at the highest political level. This made it easier to identify to involve the most influential people in the region and to convince them to take part.

Scenarios to Opportunities

The main challenge considered was the increasing need for the internationalization of Milanese industry in response to an ongoing trend of globalization and the enlargement of the European Union.



In order to guide the foresight process, a conceptual model was developed which identified six main areas influencing the internationalisation process of the local industry. The critical drivers were situated within these areas.

Fifteen Drivers of Internationalisation

Based on this model fifteen critical 'driving forces' were identified in the scenario workshop as being crucial for the internationalisation of local industry:

- Product innovation and big projects in view of their importance for international competitiveness,
- Activities at research centres as well as creative and brain-intensive activities in the region,
- Financial incentives for R&D and innovation as well as for the realization of big projects,
- Close cooperation between enterprises and research centres,
- Predominance of SMEs, characterised by slow growth and conservative acquisition strategies,
- Design and branding ('Made in Italy') as a competitive advantage at international level,
- Comparatively low quality of life within the province and especially within the city of Milan,
- Global competition due to enlargement of the EU and growing competition from new industrialized nations,
- Consumer demand for sustainable products and services as well as for increasingly complex and personalized solutions,
- The financial system and its special role for SMEs,
- Availability and continuous upgrading of human resources,
- The willingness of enterprise to take risks,
- The governance system of the Province of Milan,
- Coordination of policies at international, European, national and local level,
- Environmental and social sustainability of production as a differentiating asset.

Four Scenarios

For building the scenarios two basic variables were identified. The first was the 'Governance system' indicating the degree of integration and cooperation within the regional government and with national and supranational government levels. The second basic variable was the 'Business Model' that local enterprise might adopt. This refers to the preference of business for incremental rather than radical innovation, their consideration of long or medium term time horizons and their orientation towards efficiency rather than sustainability. As business strategy is also dependent on consumer behaviour this aspect is also taken into consideration. Although the exercise took into account the entire local industrial system, it considered in particular two technology-based sectors as well as two design driven sectors:

- Software,
- Machine Tools
- Furniture
- Clothes.

Trends, Trend-Breaks and Criticalities in Four Key Sectors

The scenarios for these sectors were created by help of personal interviews with local entrepreneurs, at least ten for each sector. This allowed the foresight team to highlight the main criticalities in relation to the geographical area of origin, of most relevant foreign competitors, their sources of competitive advantage as well as the opportunities open to them in terms of new geographical markets, and sources of supply. The four scenarios described different situations that might occur in the future. They pointed out opportunities and challenges that might arise under the specific variables assumed.

Opportunities and Challenges

In particular the scenarios highlighted the consequences and the direct and indirect impact of the basic drivers on the competitive position of local firms. It was pointed out that access to new geographical markets and defence from 'disloyal' forms of competition such as the forgery of local brands, would be crucial issues for the future.

With respect to policy, the level of coordination and integration among the different local governments, as well as their capacity of adopting a pro-active approach to addressing these issues were stressed as being important areas for future action. More integration and coordination within the governance system is seen as a major opportunity. It is believed that this will support the internationalization of local industry by enhancing the relations between enterprises and the public administration system, by making bureaucratic procedures faster and easier, and by providing better services for enterprises. More coordination with the European levels of governance is expected to lead to consistent regulations within Member States. These will facilitate international relationships, especially with the New Member States. Better contact to the national government will lead to the development of a better transport system and infrastructure which is needed to support international trade.

One challenge that was identified was that manufacturing enterprise may not be focused enough on sustainability issues. The perception is that they do not take into account long-term issues in their decision-making. Instead they focus on incremental product innovation with the aim of improving efficiency, providing higher consumer benefits and lower prices. A major opportunity is seen in the development of more flexible production systems and the reduction of costs to sharpen the competitive profile of the sector in a highly dynamic global market context.

Competition from newly industrialized economies will require Milanese enterprise to adapt their business strategies. They will have to abandon low-tech segments and concentrate on more sophisticated, more knowledge-intensive production. They may need to delocalize some of their enterprise activities to countries outside the EU.

For creative industries there are opportunities that result from concentrating on high product quality, constant improvement of the know-how of its labour force and the development of a strong brand name in international markets.

Consequences for Policy

Enhancing Cooperation and Innovation

The political indications developed at the end of the exercise highlighted actions to be taken by the Province of Milan, its governing body and its administrative entities. These are based mainly on the consideration of two contrasting scenarios which were selected as providing the most plausible and coherent frameworks for the future. One of these described a rather pessimistic 'business-as-usual' continuation of the current situation, while the other scenario represented a relatively ideal situation for the future. The overall strategic orientation for the Province of Milan is to realize the latter scenario. The specific recommendations aim to avoid the negative consequences characteristic of the first scenarios and at realizing the positive ones that characterize the attainable ideal.

Implications of the 'Business-as-Usual' Scenario

- More integration and cooperation with different levels of local authority. This implies integration and cooperation with the Region of Lombardy, the Province of Milan, and their Municipalities as well as with the national and European institutions,
- Optimize the efficiency of functions and services provided by the government to the business sector within the Province,
- Extend the infrastructure available within the Province and to its neighbouring regions,
- Improve contact with business sector in order to react in a more flexible way to their changing needs,
- Support vocational training programmes and services specific to the needs of local enterprises.

Implications of the 'Ideal' Scenario

- Adopt a pro-active approach to support the innovative activities of SMEs,
- Develop instruments for strategic intelligence in cooperation with local stakeholders from the productive and technical-scientific field,
- Promote projects in the fields of infrastructure and ICT,
- Introduce advanced quality standards in order to offer market opportunities for sustainable products and services,
- Promote innovative projects in the field of individual and collective mobility using ICT,
- Promote of innovative and systemic projects in the field of education and further training, health care and research,
- Promote of R&D in emerging fields, such as advanced materials and Ambient Intelligence, and fostering their diffusion into the productive sector by promoting the creation of new companies,
- Take on an integrative and coordinative role for private and public actors in connection with internationalization processes,
- Promote internationalization processes in terms of export orientation, delocalization of productive activities, joint ventures, technological innovation, co-operation with foreign universities, research centres and enterprises.

Beyond these specific recommendations the scenarios also indicate that future pathways regarding internationalization processes within the Province of Milan depend strongly on the behaviour of consumers, their individual values and their attitudes towards sustainability.

So far the initiative has not had any immediate follow up. After elections the regional government changed and key individuals who supported the project left their posts.

In the meantime however talks with the new government have started and there seems to be a growing interest in the results of the foresight process from the side of the new regional government.

Sources and References

- www.foresight.it
- www.fondazionerosselli.it

Anticipating Change for Europe's Industries 2020 to 2025

Authors:	Colin Blackman/ colin.blackman@ntlworld.com		
Sponsors:	The European Foundation for the Improvement of Living and Working Conditions		
Type:	The European Commission The European Council The European Parliament European Union coverage of specific industrial sectors		
Organizer:	The EMCC or European Monitoring Centre on Change/ www.emcc.eurofound.eu.int		
Duration:	Phase I 2003-2005 Phase II 2005 and ongoing	Budget: N/A	Time Horizon: 2020-2025

Purpose

Consistent with its overall mission to encourage a more anticipatory approach to dealing with change, the Industry Sector Futures initiative of the EMCC offers analyses and insights at a sectoral and European level on drivers of change, scenarios for sector futures and key policy issues and implications that will affect the future of industry sectors in Europe.

Background & Approach

In November 2002, the European Foundation for the Improvement of Living and Working Conditions launched the EMCC - European Monitoring Centre on Change - web portal, an information resource focusing on aspects of economic and social change. Established at the request of the European Social Partners and with support from the European Commission, the Council and the European Parliament, the EMCC is a place for exchanging practice, information and ideas on the management and anticipation of change in companies and industry sectors.

Sector Futures - an initiative launched by the EMCC in 2003 - provides insights at the sectoral level on the future of Europe.

The broad objectives of the Sector Futures initiative are to:

- Understand drivers of change as they apply to specific sectors of the European economy,
- Highlight possible scenarios and probable futures on a sector by sector basis,
- Provide information and links to access additional information and data at sectoral level,
- Identify and highlight topics and issues for debate in relation to the changing futures of sectors, for the companies and individuals who work in them and depend on them.

The Approach

For each sector, three 'bulletins' or articles were written by independent researchers and published on the EMCC web portal. The first sketches a broad picture of the changing dynamic of the sector, the second one presents future scenarios and the third draws out key policy issues for EMCC stakeholders. The articles are based on secondary sources and include findings from existing foresight studies, scenario work and innovation studies. These are combined with some analysis from the researchers. In its first phase, the project covered the following sectors:

- Information and Communication Technology,
- Financial Services,
- Health and Social Services,
- Publishing and Media,
- Automotive,
- Textiles and Leather,
- Food and Drink Manufacturing,
- Transport,
- Knowledge Intensive Business Services.

At the time of writing, the EMCC is planning a second phase of work with the intention of covering:

- Childcare services,
- Hotel and catering,
- Chemicals,
- Performing Arts,
- Defense Industry,
- Biomedical health.

Drivers of Change and Sectoral Scenarios for Europe

By the spring 2005 the Sector Futures project of the EMCC had explored the future of eight industry sectors in Europe. The findings for these completed sectors can be summarized as follows.

Information and Communication Technology

The main technological drivers of change in this sector are:
- Miniaturization and new materials,
- The Internet & Wireless,
- Convergence of Telecoms, IT and Broadcasting,
- Ubiquitous computing & ambient intelligence.

The main economic drivers are the:
- Falling cost of telecoms,
- Liberalization of markets, and
- Regulation.

The Socl drivers are:
- Personalization,
- Flexibility, and the
- Digital divide.

Two opposing Future Scenarios have been put forward:

1 - Stumbling Along: A world characterized by continuing innovation in ICT at a moderate pace and with moderate levels of social and economic resistance to new technology. Communication costs have not fallen dramatically, and there are continuing problems to do with security, privacy and social inclusion.
2 - Grave New World: A kind of 'futuristic dystopia' exists with fantastic technological possibilities but severe social and political problems. There has been a paradigm shift in innovation with convergence between ubiquitous computing, ubiquitous communication and intelligent user interfaces. The divide grows between the wealthy, educated, employed and information rich and the unemployed, uneducated poor underclass.

Financial Services

The main drivers of change in the sector are sector restructuring such as the:
- Introduction of the single market,
- Mergers,
- Globalization,
- Niche markets).

IT is driving change via the introduction of
- E-Banking
- Virtual money.

Social trends such as
- Europe's 'pension time bomb' and the
- Role of the state,

Play an important role and the environment is a driver due to:
- Climate change.

Three scenarios are envisaged for this sector:

1 - The 'Surprise-Free' Scenario: A world where the single market and its common currency, continuing globalization, an extensive use of information technology and new employment opportunities shape the financial services sector.
2 - The 'Alternative' Scenario: The Euro has not been universally adopted following its rejection in a number of national referenda.
3 - The 'What if?' Scenario: This is characterized by a slow recovery in the stock market, increasing personal and government debt, and the domination of financial markets by derivatives, created an accident waiting to happen. A terrorist attack brings financial meltdown.

Health and Social Services

The main drivers of change in this sector are:
- Demographic and societal change,
- Rising expectations and consumerism,
- Health Informatics and Telemedicine,
- New medical technologies,
- Spiraling costs of health and social services provision.

The three scenarios for this sector are:

1 - Best Guesstimate: A vision in which many of the targets set today are met by 2015-2020. Life expectancy moderately increases, with some of this increase spent in good health. Individualism and consumption are stronger than today but society still holds together.
2 - Problem Plagued: Where today's reforms are ineffective and health and social services are in a state of perpetual crisis. Increases in life expectancy are low and are spent in bad health, with the elderly viewed as a burden on society.
3 – Visionary: Where life expectancy increases by 10 years, well beyond current projections. This is attributed to people taking more responsibility for their own well-being, as well as the development of new radical technologies, such as tissue engineering and anti-ageing therapies.

Publishing and Media

The main drivers of change in this sector are economic and political drivers such as:
- Economic health,
- Competition and
- Regulation.

Technological drivers such as:

- Digitization and convergence,
- Spectrum abundance,
- Continuing innovation in ICT.

Social and cultural drivers such as:

- Personalization,
- Customization,
- Competing for leisure time,
- Global v local.

Two scenarios were put forward:

1 - From Free to Paid-for Content: After the bursting of the Internet bubble, there is a more realistic attitude towards financial sustainability. Revenues and profitability are now seen as fundamental to long-term sustainability,
2 - Great Expectations: here there are advances in delivery technologies and innovations in content combined with moderate governmental intervention.

Automotive Industry

The drivers of change are:

- Increasing global vehicle fleet,
- Congestion,
- Changing patterns in vehicle production,
- Impact on the environment,
- Reliance on oil,
- Development of new fuels and
- New materials, safety, navigation.

The future scenarios for this sector area:

1 - Safe and Sustainable Transport: A scenario in which technological development by industry linked to good government policy has created a safer and more sustainable transport system. Individual personal transport - the car still plays a major role but is part of a more coordinated system.
2 - Consumer Revolt: In which the continuing availability of cheap oil has undermined the attempts of policy makers and manufacturers to promote alternatives to the internal combustion engine.
3 - The Wild Card Scenario: Rapid global warming leads to the acceptance of stringent emission reduction targets. Taxes on oil increase, the income being devoted to developing alternative technologies and alternatives to transport.

Textiles and Leather

The main drivers of change here are international trade relations, organization and structure of the industry, new and emerging technologies, human resources and the enforcement of international rules and conventions.

Although no scenarios were available for this sector the standard forecast approach was employed. Developer by the IAF - Institute for Alternative Futures drivers are analyzed to deduce alternative futures according to three distinctive patterns of development:

- An Alpha Outlook representing 'business as usual', a
- Beta Outlook that considers in particular some of the many things that could 'go wrong', and a
- Delta Outlook that considering potential changes in direction.

Food and Drink Manufacturing

The main drivers of change include economic trends such as:

- Globalization and Regionalization,
- Competition and Consolidation,
- A desire for cheap food,
- Engel's Law &
- New delivery methods.

Technological drivers include:

- Novel foods,
- GMOs &
- ICT.

Demographic and social change drivers through:

- Population dynamics,
- Market segmentation and
- Dashboard dining.

Safety and environmental trends that affect this industry include:

- Food safety,
- Sustainable development,
- Green procurement,
- Diet, nutrition and consumer demand.

The three scenarios that emerge are as follows:

1 - The Production Paradigm: Driven by the 20th century's need to produce more food but increasingly leading to public health problems including heart disease, obesity, cancers, diabetes, and diet-related diseases.
2 - The Life-Science-Integration Approach to Health: The focus is the individual, the personalization of diet, and the exercise of consumer choice. Food manufacturers and retailers test for predisposition to diseases and offer personalized medicine and diets through the growing science of nutri-genomics.
3 - Ecological Integration: The concerns of nutritionists and environmental scientists have been heeded and a broader approach is been taken to harnessing the food system in pursuit of improving human and environmental health as a whole.

Transport

The main drivers of change in this case are economic drivers such as:

- Activity Patterns,
- Access, Spatial structure & Organization.

Science and technology drivers that relate to the

- Environment & Energy

As well as political and institutional drivers such as:

- Demography,
- Attitudes & other social developments.

There are two main scenarios:

1 - Business as Usual: In this case society is characterized by medium economic dynamism and accompanied by comparable technological progress however there is little public support for the excessive promotion of a sustainable society.

2 - Unrestricted Growth: Society is characterized by high economic dynamism and rapid technological progress. There is little public support for the excessive promotion of a sustainable society. The maximization of income is the guiding principle for the whole of society.

Policy Issues

This work on Sector Futures concludes with a discussion of the main policy issues raised by the scenarios for each sector. The exploration of policy issues is largely based on secondary sources. These discussions attempt on a sector by sector basis to outline major policy issues of concern in the future. Although there are no overarching policy conclusions, the detailed discussion for each sector is contained in the sector reports available as listed below.

Given that this work was based on secondary sources, the findings and depth of coverage varies considerably from sector to sector. We found that for some sectors such as:

- Textiles and Leather,
- Financial services, as well as
- Food and drink manufacturing.

There was surprisingly little published work to draw upon in terms of proper foresight exercises, futures research or sectoral scenarios focusing on the future of the sector in Europe.

In other cases, most notably Information and Communication Technologies, the opposite was true. Moreover when sectoral studies were available, they were often limited in their usefulness for various reasons. For example foresight studies in relevant sectors were available but were not conducted for Europe. Many studies were conducted very broadly across more than one sector, or within a very specific context for example to explore only environmental implications. Many did not consider aspects of particular concern to the EMCC such as impact on employment and working conditions.

The project suggests that even though there has been growing interest in foresight in Europe in recent years, there is a gap in terms of relevant primary research and considerable scope for improvement in the existence and availability of foresight relevant research.

Sources and References

By spring 2005 the Sector Futures project of the EMCC had explored possible futures for eight sectors in Europe and created 24 separate articles covering trends and drivers, scenarios and policy implications. These articles are all available at **www.emcc.eurofound.eu.int/sector_futures.htm.**

Danish Technology Foresight 2015

Authors:	Sami Mahroum, ARC Systems Research/ sami@mahroum.net		
Sponsors:	The Danish Government		
Type:	The project has a national scope and involves conducting eight sector-focused foresight studies. Only 4 focus-areas were selected in the first year in order to allow for flexibility in making final choices.		
Organizer:	The Danish Ministry for Science, Technology and Innovation		
Duration:	2001-2005	Budget: 3.2M	Time Horizon: 2015

Purpose

The purpose of this technology foresight exercise is to gain insights into, and prepare for, future technological developments, market and social needs. It seeks to do so by developing well grounded advanced scenarios on future technological and societal developments that would engender a social debate and dialogue around the future and would help policymakers in setting policy priorities.

Context and Methods

Context of the Exercise

The exercise is meant to assist government ministries and agencies formulate and develop a framework for new research programmes. It was intended to align the Danish national innovation system with important future technology and competencies needs, and in particular with those of the business sector.

Specific Objectives

- To develop insight into and prepare the system for technological and social requirements of the next 10 years.
- To create future-oriented scenarios as a basis for priority-making in research, product and process development & market development.
- To assist in public priority-setting in the area of research, technology and competence development.
- To develop and consider methods and concepts for conducting technology foresight which could be later used by private and public sector organisations in any future oriented strategy activity.
- To create networks and stimulate dialogue on future challenges and opportunities between industry, innovation system organisations, and interest groups.
- To support broad societal debate on possible, desirable technological developments.

Methods

A Secretariat for the project was set up composed of a mixture of technologists, administrative personnel, and process execution experts.

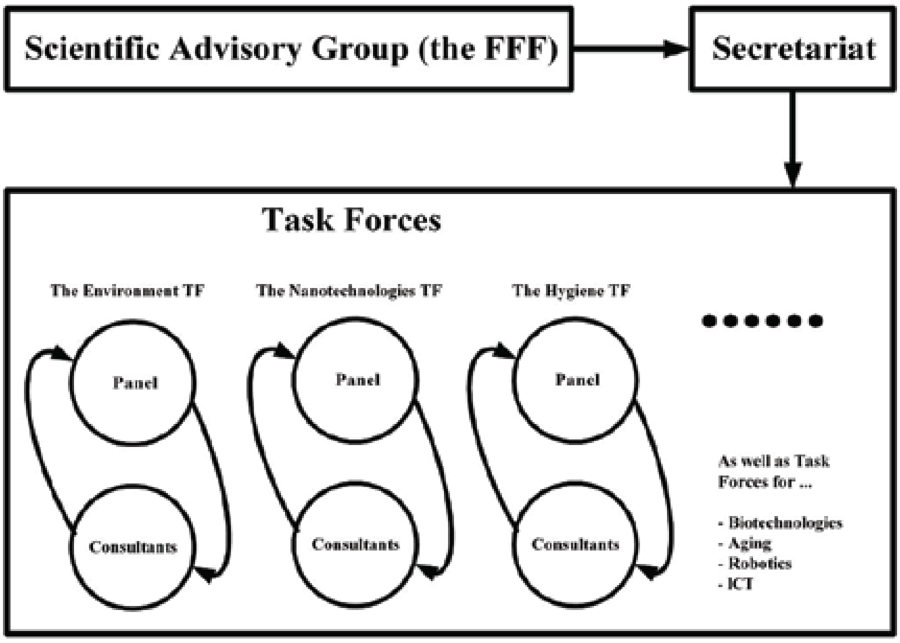
The Ministry then, after consulting various stakeholders, formed a Scientific Advisory Group - the FFF or Forsknings Faglig Følgegruppe. The FFF initially consisted of three persons but more people were added as time went on to contribute ideas, to advise to the project and to follow and monitor ongoing activities. They provided an overview of issues, analyzed results and highlighted their relevance to the overall objectives of the exercise.

Steering groups or panels were formed for each focus area that balanced technology expertise with economic and society insight. The members of the panel included directors of businesses, leaders of research institutes, representatives of sectoral associations and interest groups. They were selected on the basis of consultation between the FFF and the Ministry. Their role was to interact with outside consultants who provide more detailed analysis and support to the panel members. They panels are required to analyze and develop visions in the form of scenarios and suggest initiatives for the future.

The exhibit below provides a graphic illustration of the organization of the ongoing Danish Foresight initiative.

Content & Findings

The foresight project focused on seven themes, the Environment, Biological and Health Sciences, ICT, Hygiene, Nanotechnologies, Aging and Robotics. Work on the last two themes is still in progress. Under each of these themes, areas of application for Denmark and the technologies needed were identified.



Many inter-dependencies exist between themes. For example themes such as ICT have links to Health as well as to Agriculture and Nanotechnologies. Health is also linked to hygiene and the environment. This merely reflects the nature of the problems and challenges that Society faces and the contribution that different disciplines make in providing solutions that address real-world challenges. This also means that the same problems and solutions can appear under different themes and that the different task-forces do not always report results in a similar format.

What follows is an attempt to outline the basic content and the key findings of the work done by the different panels to date:

The Environment Panel

This panel identified the following critical areas for the future:

- Biological resources – water,
- Biological resources – spatial planning,
- Consumption of mineral resources,
- Consumption and spreading of chemicals.

It concludes that the following technologies are required to address these critical issues:

- Flexible energy systems using wind power: Flexible systems for electricity and heat product ion are the core in increasing the usage of wind energy, and Denmark is working on a broad front in developing hardware and software.
- Systematic optimization of energy consumption in buildings: Denmark has major potential for achieving energy savings by further developing integrated systems and concepts, especially with opportunities existing in new and smart buildings. Denmark has a competitive advantage in energy savings buildings, new materials, building components, insulation, etc.
- More environmentally-friendly agricultural production: The perspectives of targeting precision agriculture and organic farming which are knowledge intensive and enable the targeting of high value crops. Precision agriculture combines IT, remote sensor and robot technology together with further development of traditional agricultural machinery. Organic farming is based on the idea that farming should be part of a natural biological cycle with main aims are to avoid pollution, to maintain/ increase fertility of the soil and work on more closed substance cycles.
- Design of green materials and products: Denmark is at the forefront of the development of green products based on environmentally-friendly materials and processes – i.e. green design.

The Bio & Health Panel

This panel identified the following critical areas:

- Health problems related to aging, nutrition, and life style,
- Health care structure, including shortage of health workers, costs, & management,
- Patient relations, focusing on better quality, treatment of inter-related illnesses, personalized care, and more responsibility to the patient,
- Ethical issues arising from new technologies and new procedures.

To address these issues the following technologies will play a key role in the future:

- Human genomics and proteomics (including products such Personal Genetic ID Cards, prenatal analysis,

gene therapy, etc.): In the field of human genomes and proteomes, the mapping of the human DNA has paved the way a paradigm shift towards individualized and preventive forms of care based on genetic disposition, targeted screening, diagnostics and innovative medical treatments. These include: screening for genetically determined characteristics, more individualized and targeted treatment of diseases and improved prevention of human pathogens (viruses and bacteria transmitted by humans).
- Stem Cells (for the treatment of neurodegenerative illnesses, traumatic brain and spinal cord injury, etc.): The research in stem cells from early-stage human embryos, as well as from various types of tissue from adults, aims at engendering many exciting perspectives for developing new forms of treatment in which stem cells are used to replace malfunctioning cells or tissue (stem cell-based cell therapy).
- Bio-electronics (such nano-robots, biological computing, biosensors, biochips, electronic implants, etc): Bioelectronics presents many interesting opportunities for fields such as medical equipment technology (including the development of electronic implants for rehabilitation, etc.) and biosensors for monitoring purposes. Recent research in cell properties, and the way they interact with their surroundings, has paved the way for new forms of integration and interaction between biological material and electronic systems, and nanotechnology has permitted the examination and understanding of systems right down to the atomic level.
- Pervasive Healthcare (such as automatic and mobile monitoring, virtual hospitals, etc): Pervasive healthcare could be used to give patients, relatives and staff better access to information as and when they need it. There are also many possibilities for home care – healthcare and treatment in the home. Pervasive healthcare can be seen as a way of improving care, communication and the use of resources, and thus has the capacity to optimize the health sector in many areas.

The ICT Panel

Areas identified as being critical for the future include:
- Pervasive computing - computers will play a bigger role in our daily life and surroundings. By 2012 many of the largest Danish companies will have positioned themselves as technology-developers because of their ability and determination to use and integrate pervasive computing into existing services and products.
- Health services - this is seen as a sector where Denmark could start from in its application and development of pervasive computing.
- Facility management, especially of large building, constructing projects, etc.
- Security (digital ID etc).
- Food, this is an area where Danish companies are internationally competitive.
- Entertainment, this is a fast growing area in Denmark especially games and film production.

Key technologies for the future include:
- Communication networks and infrastructure,
- Energy saving ICT technology, such as improved batteries and electrical consumption technology,
- MEMS - Micro-Electronic-Mechanical Systems, silicon technologies, sensors, micro-mechanical components, etc.,
- Screen Technologies such as OLED - Organic Light Emitting Diode, LCD and digital paper technologies, etc.,
- Software technologies.

The Nanotechnology Panel

As a new emerging field its areas of applications remain not so well defined but they are believed to be pervasive in their impact. Denmark is expected to play a leading role in the future development of this technological field. The following technological areas were identified as being critical for the development of the domain and to have a strong relevance for Danish society and its economy:
- Nano-medicine and drug delivery including the establishment of a nano-technology centre for cancer research,
- Bio-compatible materials,
- Nano-sensors and nano-fluids,
- Plastic-electronics,
- Nano-optics and nano-photonics,
- Nano-catalysts & heat technology,
- Nano-materials.

These selected fields are areas on which Denmark can build, benefiting from existing research of national excellence and seizing the opportunity to develop whole new industries of strategic importance for the future.

The Hygiene Panel

Hygiene is seen as being of strategic importance in Denmark for the following reasons:
- Infection related illnesses are responsible for about 25% of disease related death worldwide,
- Infections cost Denmark about €250M each year,
- Increased incidence and risk of global spread of infectious diseases,
- Growing resistance of micro-organisms to antibiotics,
- An aging population with reduced immunity,
- Increased mobility between world parts and regions.

The following areas of study have been identified as being critical for the future:
- Bacteria transfer from food to people, between people,

and resistant (of anti-biotic) viruses (including cold & flu) and bacteria,
- Food poisoning and intestinal diseases,
- Relationship between antibiotics and resistance,
- Alternatives for existing hygiene practices.

Addressing these issues will require advances in the following technologies for the future:
- Technologies for hygiene in hospitals and other intensive care environments,
- Technologies for hygiene in public and community institutions such as kindergartens, schools, prisons, etc
- Technologies for hygiene in the workplace,
- Technologies for hygiene in food products,
- Technical Hygiene (technologies for water distribution and sewage handling etc).

Conclusion & Policy

The various Danish Task Force panels have taken existing national strengths as their starting point. The general message that has come out from the completed exercises is that Denmark will need to focus on sectors and areas in which it has a comparative advantage and where it can make a difference. Denmark has particular strengths in the:
- Environmental and Energy Markets,
- Agriculture, Food and Nutrition,
- Health, Public Services and Infrastructure.

Accordingly panelists emphasized the importance of interdisciplinary research as a tool that would help make new and emerging technologies more relevant to Danish needs. The real challenge for the future will be the ability to fuse different bodies of knowledge together and work across multidisciplinary teams. The latter will have to be consolidated in the form of institutions. Thus, new multidisciplinary institutions will have to be built to reflect the future. The proposal for a nanotechnology centre for cancer research is a case in point.

The main recommendations made to the policymakers in academia, government and in industry focused on the following:
- Integrating technologies, products and services by cooperating across various fields of applications,
- Interdisciplinary training and education at schools and universities,
- Multidisciplinary research teams and institutes.

Sources and References

At the time of writing this Foresight exercise is yet quite complete. The brief is based on information available at **www.teknologiskfremsyn.dk.**

Foresight Vehicle Technology Roadmap 2020 Technology and Research Directions for Future Road Vehicles

Authors:	Sami Mahroum, ARC Systems Research/ sami@mahroum.net		
Sponsors:	The British Department of Trade & Industry with support from industry and several other government departments		
Type:	A sectoral foresight dealing with the technological future of the automotive industry		
Organizer:	The SMMT - Society of Motor Manufacturers & Traders		
Duration:	N/A	Budget: N/A	Time Horizon: 2020

Purpose

The exercise had the goal of identifying market and industry trends and drivers for the automotive sector over a 20 year time horizon. In addition, performance measures and targets for the road transport system were defined. The technologies needed to meet these targets and the research required to deliver them were discussed. This foresight exercise was carried out in the context of a £100M programme whose current phase started in 2001 with a revision in 2003.

Road-mapping the Future

Within the framework of Foresight Vehicle, which is a knowledge transfer network for the automotive industry, a collaboration between industry, academia and government, a ‘technology road-mapping’ initiative has been set up to provide a framework for ongoing investment in research partnerships and to focus efforts on achieving sustainable wealth creation and quality of life. Foresight Vehicle itself was established in the context of supporting the recommended actions of the UK Automotive Innovation and Growth Team (AIGT). The latter comprises major stakeholders from the automotive sector who came together to identify the issues most likely to have the greatest impact on the long-term profitability and productivity of the sector in the United Kingdom.

The foresight programme has three main objectives:

- Encourage technological innovation in road vehicle systems in the short, medium and long term,
- Enable communication, discussion and action within industry collaborations, academia and networks,
- Map future innovation paths for a number of key technology areas.

The foresight programme was based on a ‘Roadmapping’ process which brought together more than 130 experts from across the road transport sector. These came from more than 60 organisations, including industry, academia and government. The exercise was based on a series of workshops and supplemented by a web based questionnaire emailed to respondents.

The goal was to use the roadmap structure to capture and share the rich set of views about how road vehicle markets, products, systems and technologies would or could evolve over the next 20 years. One of the main guiding principles in this foresight initiative was to base the technology roadmap architecture on the relationship between technology developments and system performance as well as trends and drivers.

With regards to technology developments, a broad definition of technology as ‘know-how’ was adopted which emphasized the application of knowledge. This included ‘hard’ technology, based on science and engineering principles, as well as ‘soft’ technology, which includes the processes and organizational models required to exploit science and engineering know-how effectively.

Technology, Drivers & Trends

Five technological areas were identified by the experts as having significant potential to deliver high impact technology solutions to meet the social, economic and environmental goals:

Engine and Powertrain Technologies: These would lead to improved thermal and mechanical efficiency, performance, drivability, reliability, durability and speed-to-market, together with reduced emissions and cost.

Hybrid, Electric and Alternatively Fuelled Vehicle Technologies: Leading to new fuel and power systems, such as hydrogen, fuel cells and batteries to satisfy future social, economic and environmental goals. Activities are concentrating on reducing fuel consumption of conventional vehicles, together with developing alternative energy and power systems, such as hybrids, electric and alternatively fuelled vehicles. Hydrogen and fuel cells are of particular importance, although it is likely to be 15-20 years before such systems will become widely available.

Advanced Software, Sensor, Electronic and Telematics Technologies: Their development will lead to improved vehicle performance, safety, control, adaptability, intelligence, mobility and security. The content of electronics and software in new vehicles will continue to increase in areas such as control and intelligence, telematics, information and service provision, entertainment and user interfaces. Many of these functions will require parallel development of the infrastructure to enable communications and system level control. The development and agreement of international standards will be a key enabler.

Advanced Structures and Materials Technologies: These will lead to improved safety, performance and product flexibility together with reduced cost and environmental impact. Interesting new materials technologies include lightweight alloys and polymers, fluids, coatings, biotechnology and nanotechnology.

Design and Manufacturing Process Technologies: These will provide improved industrial performance, considering the full vehicle life cycle from 'cradle to grave'. Newer flexible, manufacturing technologies have the opportunity to service different industry sectors and provide better returns on investment.

Six broad trends and drivers were identified and used subsequently to structure the information contained in the roadmap. These trends and drivers were not treated independently however. Rather they were seen as interdependent (for example, the related issues of vehicle fuel efficiency and CO_2 emissions have significant implications for society, economics, the environment, technology, politics and infrastructure).

The main trends are as follows:

Social Trends & Drivers

These relate to the social systems we live in, include:

- Demographics,
- Life style aspirations and choices,
- Mobility requirements and behavior,
- Working patterns, and
- Desires for health, safety and security.

With continued growth in GDP forecasted at 3% per year until 2010, there is growing demand for mobility of passengers and goods. This is stimulated by economic growth and development together with changes in lifestyles and working patterns. The road transport system plays a central role in this as 80% of journeys made by people are made by car. Associated road traffic growth is predicted to increase by 20% over a 10 year period. Living and working patterns are expected to change, with increasing mobile and home working enabled by improved information and communications. There is also a need to anticipate and provide for demographic changes brought about for example by the ageing of the population and by growth of industrial and urban areas. Social demand for improved health will continue to encourage efforts to reduce emissions and particulates.

Economic Trends & Drivers

The economic trends and drivers relate to the financial systems that affect our lives. These bring together a number of global and national as well as corporate and personal economic considerations. The participants in the foresight programme considered that the following economic drivers would prove key determinants for the future of the sector:

- The development of advanced manufacturing methods is required particularly to take advantage of new materials and structures. The elimination of processes such as paint shops will bring both environmental and economic benefits.
- Design systems are required which will significantly reduce development time and raise value. The introduction of more sophisticated virtual engineering tools for all aspects of vehicle design is required with the ultimate target of 'zero prototypes prior to Job 1'.
- Technologies aimed at increasing the effective life of a vehicle whilst enabling the upgrading of emissions and safety systems are needed. Preventative maintenance via onboard diagnostics can reduce operational costs, whilst more durable components, capable of operation in a zero maintenance environment, are required.

Environmental Trends & Drivers

These relate to the physical environment in which we live. They include energy production and consumption, waste, emissions and pollution, as well as associated health impacts. Experts participating in the exercise believe that continuing legislation, technological developments and progressive replacement of the vehicle fleet by more modern vehicles will reduce vehicle emissions to less than 20% of their 1990 level by 2010, even though increasing transport demand and congestion will have a counter effect.

Technological Trends & Drivers

These relate to how technology affects the way we live, including development of new fuel and power systems, electronics and control technologies, structures and materials, together with manufacturing and business processes.

Political Trends & Drivers

These relate to policy, regulation and legislation, together with the political processes that lead to them. Government targets have been set for reductions in:

- Congestion,
- Noise,
- Maintenance of roads, bridges and lighting,
- Improved information, booking and ticketing systems,
- A 40% reduction in deaths/serious injuries, and
- An accelerated take-up of cleaner vehicles.

Energy and CO_2: This is a major area where government seeks to influence the automotive sector. Clear targets are specified for improved fuel efficiency and the total level of CO_2 and other greenhouse gases produced as a by-product.

Waste: End-of-life vehicle policy is shaping the future of the industry. Currently vehicles have one of the highest recycling rates - more than 75%. However by 2015 it is expected that 95% of vehicles will be recyclable, with only 5% destined for landfill.

Health and Safety: The UK 10 Year Transport Plan underlines a desire to reduce road deaths and serious injuries. Targets of 40% reductions in deaths and serious injuries, and 50% fewer children killed or seriously injured, have been set for 2010. This needs improvements to infrastructure as well as vehicles as required by UK, European and Industry agreements and standards and regulations.

Infrastructural Trends & Drivers

These concern the systems that support road transport, including the physical roads and infrastructure, together with provisions for associated services and information, as well as interfaces with other modes of transport.

Improvements in communications bandwidth and computer processing power will provide opportunities to improve the overall road transport system performance, in terms of traffic management, reduced congestion, information services, improved safety and security.

If alternative energy and power systems are to be developed and deployed widely in vehicles, then appropriate fuel distribution networks will need to be established.

The effectiveness of the overall transport system demands that infrastructure is dealt with and re-designed in an integrated way providing links between the road and other transport modes be considered. Integrated transport requires the synchronization of information systems that include systems for timetables & integrated ticketing, as well as accurate and up-to-date information services for both passenger and freight.

Partnership & Investment for the Future

The United Kingdom and European political systems and processes should underpin the delivery of an efficient and effective road transport system, which requires a partnership between the private and public sectors. The long-term capital investment associated with infrastructure requires stable and integrated policies, while environmental targets require a willingness to develop and abide by international agreements. Issues of particular importance in Europe, include the liberalization of markets such as the liberalisation of the freight market by 2008 and the harmonization of legislation and standards.

Investments in road vehicle technology and research should be considered in terms of the contribution that the investment is expected to make towards the achievement of primary social, economic and environmental goals of:

- A socially sustainable road transport system that provides equitable, safe and secure road transport able to meets the needs and aspirations of UK society,
- An economically sustainable road transport system supported by a dynamic and successful UK automotive industry,
- An environmentally sustainable road transport system that has a low environmental impact in terms of energy consumption, global warming, waste and health.

The British Department of Trade & Industry has established a special unit to follow up on findings and recommendations made by the various initiatives undertaken in this sector, including those resulting from the Foresight Vehicle programme.

The Automotive Innovation and Growth Team (AIGT) called on supplementing Foresight Vehicle by other initiatives such as the set up of an automotive international academy to continue working on and developing the sector further into the future.

Sources and References

This brief was based on a publication entitled 'Foresight Vehicle Technology Roadmap Version 2.0: and research directions for future vehicles'. This was published in 2004 by Society of Motor Manufacturers and Technology Traders Ltd. Forbes House, Halkin Street, London.

Archaeology in Ireland 2020

Authors:	Prof. Gabriel Cooney/ Gabiel.Cooney@ucd.ie Prof. Liam Downey/Liam.Downey@mail.com Dr. Muiris O'Sullivan/ Muiris.OSullivan@ucd.ie		
Sponsors:	The Heritage Council, The Institute of Archaeologists University College Dublin		
Type:	National sectoral foresight in the field of archaeology		
Organizer:	University College Dublin – Contact Dr. Muiris O' Sullivan at Muiris.OSullivan@ucd.ie		
Duration:	2004-2005	Budget: € 20 000	Time Horizon: 2020

Purpose

Since the 1990s there has been explosive growth in the number of construction and public works related archaeological excavations carried out in Ireland. As a result archaeology has become a business activity. It operates in a competitive climate radically different from that of the traditional university research environment. Although the primary purpose of archaeology is to create knowledge about the past, systemic failures have emerged with the result that most of the knowledge created in the course of construction related digs will effectively be lost to science. The goal of this foresight exercise is to bring together all relevant stakeholders, develop a vision for the role of archaeology in Irish society in 2020, propose recommendations that will address systemic weaknesses that have emerged along with the rapid growth in the number of archaeological excavations and propose additional measures to ensure an appropriate management of this important aspect of Irish cultural heritage.

Factors Driving Demand for Archaeological Services

An increase in the number of major infrastructural projects for road development, gas pipeline provision and urban-renewal under the National Development Plan have lead to a rapid increase in the number of archaeological excavations carried out in Ireland each year. The number has increased from a level of 50 to 60 excavations a year in the mid 1980s to about 2000 excavations in 2002. This level of development is expected to continue at least until 2012 and possibly beyond.

Other forces will contribute to an increase in the demand for archaeological services. These include changes to land-use brought about by the amalgamation of farms and the destruction of ditches, earthen banks and field boundaries to create larger more uniform fields better suited to competitive agricultural production.

This will be accompanied by an increase in the land under forestry from the current 9.5% to about 17% in 2020. The development of forest will have an impact on the rate at which archaeological sites must be excavated and peat extraction will continue to reveal new sites until Irish peat resources are exhausted in about 2015.

Technological developments in the use of Geographical Information Systems and new geophysical techniques applied to modelling and even prediction in the field of archaeology will continue to change the range of tools and services available in the future.

The Current Status of the Sector

The number of archaeology consultancies advertising in Ireland has increased fourfold since the mid 1990s. The number of archaeologists employed in the private sector is 650 compared to an average of 13 to 18 full-time-research-equivalent archaeologists employed each year in academia throughout the last decade. Since 1970 there has been a 250% increase in the number of students taking archaeology at university. More than 95% of all archaeological excavation is now under taken by the private sector. Archaeology must now be considered a private sector business domain.

In the late 1990s the Irish Heritage Council identified a backlog of 1353 unpublished excavations. The current number is at least an order of magnitude higher than this. Most of the data created by private consultancies in the course of their excavations are not available to the research sector for further study. The quality of excavation reports is not unform and only about 5% of excavation reports are suitable for publication. Most of these require further analysis and interpretation before they could be published. Much of what has been archived in terms of reports and unprocessed samples is apt to deteriorate with time.

Delays to the development of roads and other infrastructure caused by excavations and a failure to disseminate and communicate the value and significance of findings, has given rise to a growing public disenchantment with archaeology.

The institutional landscape of state bodies concerned with the protection and management of Ireland's cultural heritage is fragmented. It is no longer able to respond to current needs in terms of the creation and management of archaeological data.

Issues and Challenges

The two main issues to be addressed in order to overcome the systemic failures identified above are:
- The lack of cohesion between compartmentalised operations and requirements of the different public organisations and agencies involved in archaeology,
- The lack of knowledge created on the basis of the great volumes of data being generated by development lead archaeological excavations.

The main challenge for the future is to arrive at a series of institutional arrangements that can unlock the value inherent in the archaeological work that has been carried out and that will continue apace until about 2020. In essence this is the challenge of moving the emphasis away from the generation of data towards the creation of knowledge about our past.

Methods

The main approach has been to identify and engage all major stakeholders, draft of position papers, invite commentary and support a process of mutual learning and deliberation in a series of consultative fora.

Stakeholders

The majors stakeholders involved in this process included representatives of:
- The National Roads Authority,
- The Construction Industry Federation,
- The Irish Concrete Federation,
- Private sector consultancies,
- The Department of Agriculture and Food,
- The Department of the Environment, Heritage and Local Government,
- Bord Na Mona,
- The Department of the Environment NI (Northern Ireland),
- The National Museum of Ireland,
- The Heritage Council,
- The Royal Irish Academy,
- The Institute of Archaeologists of Ireland,
- The Royal Society of Antiquaries of Ireland,
- Cork City Council, and
- Departments dealing with Archaeology at UCD, UCC and Queens University Belfast.

Re-Positioning Archaeology in 2020

The current focus in development-lead archaeology is on the production of data or information and its management. A vision of a 'Knowledge Archaeology' has emerged however in which due emphasis is given to archaeology as a source of knowledge-creation.

This vision is summed up in the term 'development-lead knowledge-archaeology'. The challenge now is to re-position archaeology in Ireland - dominated as it is by commercial archaeological activities - as a knowledge creating process.

This vision for the place of archaeology in Irish society in 2020 is informed by an observation that Irish society is changing rapidly and becoming increasingly culturally diverse. It is important to establish and interpret a good record of the past before important elements of the national identity and cultural heritage are lost for all time.

Operational Considerations

An important lever could be the concept of value-for-money in the procurement of archaeological services associated to development projects. It is important that value is recognised in the creation of knowledge rather than in the generation of data. Procurement processes could consider service providers who create knowledge as providing better services than those who merely generate data.

To optimize the knowledge creation potential of development lead archaeology priority questions derived from an island-wide archaeological research agenda could be incorporated into the development-lead excavation project.

Significant discoveries made during excavations on the basis of current practise are not systematically incorporated in to the broader archaeological research agenda. Provision should also be made for the proper investigation of potentially new and unexpected insights and features in the course development lead-excavation projects.

Development lead archaeology should be incorporated into national archaeological research activities or much of the value potential in excavations will be lost.
The quality of excavation reports should be managed in a way that facilitates their systematic publication.

Strategic Initiatives

This process of re-positioning could be achieved on the basis of three strategic initiatives.

An Archaeological Consultative Partnership

This consists of a consultative forum that comprises senior officials from appropriate government departments and development agencies together with senior archaeologists from relevant public and private organisations. Its role would be to maintain a high level dialogue that brings together the main stakeholders in Irish archaeology.

It would develop consensus on between the various interested parties on issues relating to archaeology in Ireland.

It could cover both the Republic and Northern Ireland and provide for cross border liaison on issues of common interest.

An Archaeological Publications Bureau

It is now acknowledged that there is a need for a properly resourced system to manage excavation related publication. This is required immediately to address the backlog of unpublished excavation reports. There are already several thousand unpublished reports and at least 100 of these are considered to be of national significance. The first priority of the Publications Bureau would be to ensure the publication of backlog reports on sites of national significance. Publication should address not only the knowledge requirements of archaeological researchers but also those of the general public. Addressing this problem would cost somewhere in the region of €2-3M per year over a five year period. Although this figure seems high it is much less than 10% of the current total expenditure on excavation. The second priority should be the publication of the backlog of excavation reports that are of significant regional significance. These publications would be smaller but more numerous and the bureau could aim at publishing about 50 booklets each year. Booklets based on future excavations would be published directly from the excavation reports supplied to the bureau in a standard ready for print format.

Support for Inter-Institutional Collaboration

Although the Universities of Ireland all have good departments of archaeology, they face challenges due to the rising costs and increasingly specialised nature of modern archaeological field-work, fragmentation and a lack critical mass in their research activities. This situation could be improved considerably by support for collaboration that brought together not only the university based departments but other research institutions such as the 'Discovery Programme'. An annual budget of €1-2M would provide support for 5-10 substantial collaborative projects in archaeological education and research.

Other Initiatives

These three main strategic initiatives should be supported by a range of other measures.

- The effectiveness of an Institutional Collaboration Fund would be enhanced by the development of a **National Research Agenda** for archaeological research.
- The **continuing professional development** of private sector archaeologists also needs to be addressed.
- **A broader educational approach to the environment** would foster a broader and more holistic understanding of archaeology and its impact on development, agriculture, landscape and the economy. This would embed thinking about archaeology in the logic of the sustainable development of Irish society.

Local authorities play an increasingly important role in the management of cultural heritage and archaeological resources, but there is **concern about the capacity of local authorities** to handle the rapidly increased work-load with the resources currently at their disposal. The National Museum of Ireland and the Ulster Museum house the bulk of the national collection of archaeological artefacts. However the stock of material recovered from development lead excavation over the last 15 years has increased much more rapidly that anticipated and is likely to overwhelm existing provisions for storage. There is therefore an **impending crisis of curatorship** in the sense that the network of national as well as local museums galleries spanning the Irish Republic and Northern Ireland will not be able to cope in a meaningful way with the influx of artefacts from ongoing and existing excavations. Better field project communication and involvement of these players in local excavations is essential to the provision of an integrated high-quality service to the public.

A need exists for initiatives in the development of **archaeological practice**. Current practice is characterised by a disconnect between information generation and knowledge creation. Unless this issue is addressed directly and immediately Ireland will continue to invest in archaeological activities that ultimately have little meaning for society at large. A number of specific issues need to be addressed in this regard.

Archaeologists routinely make comparisons and judgements about monuments and sites with a view to mitigating the impact of development and with a view to the full protection of sample monuments. **An Archaeological Grading System** needs to be developed to support this process in a transparent and scalable way. Such a system would provide

a basis for:
- The allocation of resources and prioritising of initiatives,
- The assessment of grants to farmers under the Rural Environment Protection Scheme,
- The state acquisition of significant monuments to ensure their full protection.

A Monitoring System is required to systematically monitor the survival and condition of archaeological monuments and sites. It is necessary to consider archaeological sites in their wider landscape setting and develop clear **Guidelines on Archaeological Landscapes**, their boundaries and buffer zones. The system for the provision of **Licenses** to excavate should be examined with a view to ensuring the creation of knowledge rather than the gathering of information and standards for **Quality Assurance** should be developed and applied. Finally measures need to be taken to **develop public awareness** of the role of archaeology and the significance of finds. Measures are needed to engage with and **build confidence among developers** and provide them with a system for resolving disputes and addressing their concerns in relation to archaeological amelioration processes.

Sources and References

The Heritage Council Survey (1930-1997) and the report **Archaeological Features at Risk** can be obtained from the heritage Council via their website at www.heritagecouncil.ie, by sending an email to mail@heritagecouncil.com or by calling +353-56-7770777.

2020 Archaeology - Knowledge Creation through Partnership, February 2005: can be obtained from Dr. Muiris O' Sullivan – Department of Archaeology, University College Dublin, Belfield, Dublin 4, Ireland. Email him at muiris.osullivan@ucd.ie or call him at +353-1-7168315.

Foresight Embedding in Malta

Authors:	Jennifer Cassingena Harper - MCST/ Jennifer.Harper@mcst.org.mt Gordon J. Pace - University of Malta/ Gordon.Pace@um.edu.mt		
Sponsors:	EU DG Research STRATA Programme The Government of Malta		
Type:	A national foresight exercise based on a series of three pilot projects intended to introduce and systemic, fu-ture-oriented processes in RTDI policy development		
Organizer:	The Policy Unit of the MCST - Malta Council for Science and Technology/ www.mcst.org.mt		
Duration:	January 2001 to December 2003	Budget: € 200 000	Time Horizon: 2015-2020

Summary

On the eve of accession to the European Union, Malta like all new members states, experienced considerable pressure for change. This included a drive to adapt RTDI policies for participation in the European Research Area. For a small transition economy with limited resources there was a need to adopt a creative approach to policy development. In the period 2002-2003 foresight was introduced to Malta via three pilot projects conducted by the MCST. These pilot projects played an important role in breaking path-dependencies. They liberated the mind-sets of stakeholders and provided occasion for mutual learning on systemic issues. Foresight is now an integral part of the day-to-day work of the MCST which continues to promote and encourage its application to other policy domains.

The Development of Human Capital in a Small Transition Economy

Context

In a critical phase when Malta was preparing for EU accession, foresight was identified as an important tool to tackle macro and micro level challenges relating to strategic planning for the future. These included:

- Competing in an increasingly global learning economy by strengthening national research and innovation capacity and by introducing more systemic approaches to policy,
- Developing cross-sectoral strategies for the effective use of structural funds for research, technological development and innovation,
- Capturing the spirit of strategic conversations about the future that were already underway.

Overall Objectives

The overall objective of the series of foresight pilots in Malta was to elaborate a vision for Malta as an advanced knowledge economy in 2020 whose main resource would be its ability to develop human capital for a global learning economy from a Mediterranean base.

The pilots were also intended to guide MCST's decision-making in relation to its input for the National Development Plan (2003-2006). Through the foresight process itself, the target was to mobilize public-private sector partnerships to take action on business opportunities. A second aim was to revitalize old networks and to stimulate the formation of new networks. The aim was to encourage cross-disciplinary and cross-sectoral networks, involving new kinds of players such as management and HR consultants, researchers and educators). Since the project was the first experience of the use of foresight in Malta, it also aimed at exploring foresight approaches and the embedding of foresight culture and skills.

Methods

The exercise used the following methods in a stepped approach, with phases evolving in synergy over time:

- Scoping – questionnaire-based surveys and one-to-one interviews ,
- Stakeholder analysis,
- Awareness and Training in Foresight Methods,
- Panels,
- SWOT and STEEPV analysis,
- Driver Analysis,
- On-line consultation on visions and mind-mapping of issues,
- Scenario-development,
- Web-based and Dissemination.

Factoring Informal Societal Challenges

An important point of reference for the exercise was a set of formal objectives or challenges to be addressed by the Maltese government as part of the general process of integration with the European Union. These issues arose in dialogue with the European Commission and with EU member states and have been adopted as part of a policy learning process negotiated with the European which were agreed on in consultation with the sponsors, namely the EU Commission and the Government. However in the process, a number of societal challenges emerged which needed to be tackled.

Top-down or formal challenges identified by the Government as sponsor of the exercise include:

- Build capacity for strategy and policy development,
- Develop strategic intelligence,
- Develop cross sectoral synergies,
- Support public-private partnership,
- Re-align existing stakeholder networks,
- Update RTDI policy using a long term perspective,
- Make effective use of structural funds.

Bottom-up challenges that are societal in nature, which are intimately linked to the top-down challenges and important for the eventual impact and success include a need to:

- Give Science, Technology and Innovation a higher profile on the national agenda using an outreach approach,
- Promote a national culture for science and innovation,
- Encourage individual and organizational learning,
- Improve science-society links,
- Adopt a consensual approach to policy that is inclusive on a country wide scale,
- Embed foresight in the overall public policy development process.

Knowledge Community 2020 Vision: A Success Scenario for Foresight Embedding

The first foresight pilot developed a success scenario entitled Knowledge Community 2020 Vision. The orientation of the exercise was to build on the work which had been developed through the National Strategy for Information Technology with a view to taking the vision-building process forward into the emerging realities of the Knowledge Society. The emphasis was on the challenge of identifying the drivers of the transition from the information society to the knowledge society and the related knowledge management and transfer aspects.

The major challenges identified included:

- Ensuring a more holistic and integrated approach to strategic policy-making in ICT and Knowledge Management,
- Embedding foresight in key policy areas for the knowledge-based economy, and
- Allocating appropriate levels of resources to each of the pilot exercises.

Given constraints of critical mass, the exercise focused on the need to target resources to a defined set of niche areas in which Malta possesses existing strength or with areas which demonstrate a potential for developing and test-bedding new ICT applications and approaches. These included tourism, e-health and local knowledge domains linked to crafts, cultural heritage and fisheries.

The Knowledge Community 2020 Vision recommended the setting up of a National Knowledge Platform for facilitating joined-up open governance (considered as a major driver of the Vision). The Knowledge Platform is designed to activate a complementary value-added layer to the current portfolio of information services provided to the community and citizen. The Platform's services and facilities extend beyond information-sharing to knowledge-sharing. The Platform can serve as the main portal for pooling inter-sectoral knowledge, e-learning facilities and knowledge resources, on-line policy discussions and debates and fast-track learning.

The convergence of knowledge and open user-access which can be activated through the National Knowledge Platform initiative forms the basis of the second strategic thrust of the KC 2020 Vision, namely the exploitation of inter and intra-sectoral knowledge futures synergies. Knowledge futures opportunities are opening up at the interface of disciplines and sectors through the synergetic impact of information, communications and knowledge technologies. The focus on cross-thematic clustering and knowledge management are seen as key drivers of this initiative which will aim to identify complementarities between current strategies and initiatives of different Ministries and public and private entities.

The Knowledge Platform provided the basis for more streamlined, joined-up policies developed through a process of open on-line governance and the introduction of integrated resource management. The smart convergence of knowledge and innovation-driven policies, addressing collectively needs and strengths in different sectors, including health, education, culture, tourism, transport, the maritime sector and enterprise, provided the key to value-creating synergies for indigenous development, the third thrust of the Malta Knowledge Community 2020. On a social and cultural level this encouraged greater synergy between the cultural and ICT communities in Malta with a view to bring about more avant-garde and innovative artistic production was identified as another promising avenue. It was envisaged that this would put Malta at the forefront of the contemporary cultural scene.

Coping with EU Membership

The EU Accession challenge was perceived as presenting Malta with a mix of opportunities and threats. The opportunities related mainly to the economic, political, and military security afforded through membership coupled with improved quality of life; the chance however is seen in the possibility to escape from constraints of a small country and its path-dependencies thereby achieving a faster transition to the knowledge society. The threats focused mainly on negative societal impacts, including possible loss of socio-cultural identity and values, the challenge of coping with an increasingly diverse society, the brain drain, and negative effects on marginalized groups. Other identified threats related to the heavy burden and competing pressures related to compliance with the EU Acquis Communautaire, the poor/slow visibility of benefits of membership and the capture by vested interests of the opportunities opened up through membership.

Moving Closer to the Local Players

The exercise represented a creative fusion of innovation and socio-cultural foresight for harnessing the impact for optimum effect. The main challenges in implementing the pilot project series were related to a need to activate and support fast policy learning and unlearning processes, and to bridge the divide between policy-makers and Maltese society by engaging competent new actors and moving towards more consensus-oriented dialogue.

The long-term embedding of foresight skills and policy learning processes is one of the often indirect and unintended effects of foresight exercises. These effects may be taken for granted but they are not usually included by design as a core objective of a foresight exercise. Given the critical need to generate fast track societal learning, a key insight that emerged from the Maltese pilot project series was the utility of designing foresight exercises which target more directly societal and individual learning, assigning this a more central role than that assigned in most foresight initiatives.

Another insight emerging from the exercise is that less-emphasized benefits of foresight are its facility to make transparent policy processes and structures and to bring to the fore key challenges and key individuals or champions to the cause. It also helps to identify hidden obstacles to the introduction of more informed, transparent open and participatory governance processes as well as barriers that could hinder the 'wiring-up' of the national system of innovation.

A key success criterion of the exercise was the involvement in the panel of new actors beyond the established players, including domain experts (IT, law, media, business, human resources, management, education, communications, social scientists), mainly from university, consultancies and private sector training institutes, together with theatre specialists, students and policy-makers. Efforts were made to record in a detailed way the process of consultation and consensus building and all processes of the foresight pilot from scoping to implementation and evaluation thus satisfying the final success criteria. The foresight approach adopted with the first pilot provided a useful basis for the other two pilots, although these adapted and developed their own approach to design and implementation. Use of the website and mailing lists to engage strategic players, new actors and external experts in the discussions, has helped to make local players more aware of science, technology and innovation policy concerns. A shared web-based facility (space) for exchanging documents, proposals, ideas, and news has brought important knowledge and opportunities to the attention of local players and continues to be appreciated by the subscribers as a free source for receiving key STI Policy updates

- The results of the exercise were presented to key stakeholders including the Ministry for Information Technology and Investments in May 2003.
- Feedback lead to the refining of the policy recommendations and to the further definition of recommended action lines.
- The results have also been presented to the Office of the Prime Minister's Regional Policy Directorate (responsible for structural funds coordination) and there is specific reference to the role of foresight in RTDI policy development and more specifically the results in the Research and Development section of the Single Programming Document (2004-6).
- There was also reference by the Minister of Finance to eFORESEE and its results in the National Budget Speech 2002 and the updated National RTDI Strategy presented to Cabinet by MCST.
- The exercise has also helped to strengthen MCST's links with a range of players in the innovation system: the Ministry for Education, the Ministry for IT and Investments, the University of Malta, the Malta College for Science, Arts and Technology, Malta Enterprise through their involvement in the panels, as well as in the briefing, training and dissemination events and strategic consultations.
- It has also lead to the introduction and use of foresight approaches more broadly into MCST's work and activities, particularly in relation to FP6. The strong engagement of the MCST team in national and international foresight activities led to an accumulation of expertise that was subsequently transferred from one activity to another.
- The results are being used as the basis for the new proposals being drawn up by MCST for RTDI under

the National Development Plan 2007-13. The findings provide an important input for follow-up foresight activity currently underway in two ERANETs, ForSociety and MarinEra and a new foresight initiative for the Mediterranean, INNFORMED.

Sources and References

Cassingena Harper, J. and Pace, G. The Creative Processes in Policy Making: A Case for Context in Foresight. Proceedings of the Fifth International Conference on Creative Thinking, 21 - 22 June 2004, Malta.

Cassingena Harper, J. and Georghiou, L. The Targeted and Unforeseen Impacts of Foresight on Innovation Policy: The eFORESEE Malta Case Study, Int. J foresight and Innovation Policy (2005 forthcoming).

National Science and Technology Policy Document (1994) http://www.mcst.org.mt/resources/pubs/ST_policy.pdf

National RTDI Strategy (2003) Presentation http://www.mcst.org.mt/public/events/20031205ERA/2_cabinet_RTDI_july.ppt

Single Programming Document Revised version (p. 70-72) http://www.ppcd.gov.mt/english/main.htm

FISTERA – Foresight on Information Society Technologies in the European Research Area 2020

Authors:	Matthias Weber, ARC systems research/ matthias.weber@arcs.ac.at		
Sponsors:	European Commission DG Information Society		
Type:	International foresight activity covering the enlarged European Union, focusing on the thematic area of Informa tion Society Technologies		
Organizer:	The Institute for Prospective Technological Studies JRC-IPTS Telecom Italia Lab, PREST – The University of Manchester, The Institute for Technology Assessment and Systems Analysis ITAS - Research Centre Karlsruhe, ARC systems research, Gopa-Cartermill, and a network of partner organisation from 19 European countries.		
Contact	Ramon Compano of the JRC-IPTS/ ramon.compano@cec.eu.int		
Duration:	September 2002 – August 2005	Budget: € 1.5M	Time Horizon: 2020

Purpose

FISTERA is a thematic network aiming to understand the key factors driving IST in a future Europe and to elaborate options on how to strengthen Europe's position in key IST areas. As such it serves as an input to the debates on strategies to reach the Lisbon objectives and on preparations for the IST Programme in FP 7.

A Multi-faceted Approach to Europe's Future in IST and IST Research

FISTERA has been launched in time to deliver thought-provoking results that should feed the debates about the Lisbon strategy, the future of IST research in Europe in general and the preparations for FP 7 in particular.

Set in this context the main objectives of the FISTERA project can be summarized as follows:

- Understand and capture the key technological, economic, social and political factors driving IST in a future Europe,
- Elaborate a vision of the future of IST in Europe and how IST is expected to contribute to improving quality of life,
- Identify the main strengths and weaknesses of IST research in Europe and potential opportunities and threats that might enhance or erode Europe's competitive position (SWOT),
- Suggest research areas that will be crucial for realizing the IST vision in the light of the SWOT analysis.

Within the framework of a SWOT-approach for international comparison, FISTERA analyzed different types of trends and trend-breaks likely to affect the future of IST research in Europe. Technological, economic, social as well as political factors were considered as potential driving forces. The internationally comparative approach was followed in order to identify candidate areas on which to focus future research activities and funding.

Different techniques were used to explore these driving forces: review of existing national, sectoral or corporate foresight exercises, systematic mapping of technological developments and market prospects, online-Delphi, patent analysis, workshops to explore cross-cutting issues like human resources, priority-setting, or industrial strategies.

Much emphasis was put on dissemination and discussion of findings, with more than 20 national workshops and a final conference being organized in the course of the project, and an online IST Futures Forum being created on the web.

Exploiting Technological Trajectories and Disruptions in Key Application Areas

FISTERA Scenarios - between Competitive Performance and Techno-economic Heterogeneity

In FISTERA, future developments in IST have been investigated from different perspectives. In order to capture different future socio-economic contexts for IST, four alternative future scenarios of the knowledge society were explored. These scenarios served as the backdrop against which to assess the importance of different application areas for the future of IST. The four scenarios were constructed along two main dimensions: European competitive performance, and European internal techno-economic heterogeneity to explore the implications of the project's findings. The stakeholder group will meet in autumn 2005 to assess progress against the Action Plan.

Scenario 1 Progress and polarisation Competitive and Dynamic Knowledge Society: • Rapid growth in IST use • econmoy- driven innovations • uneaven development	Scenario 2 Catch Up and creative Cohesive and Integrated Knowledge Society: • Rapid growth in IST use • econmoy- driven innovations • much reduction in disparities across EU
Scenario 3 Challenged and contested Challenged Knowledge Society: • slow and very uneaven growth in IST use • innovations in specific areas • major concerns about technology & market	Scenario 4 Doing things differently Sustainable and Inclusive Knowledge Society: • New paradigms of IST use • social and community - driven innovations • environmental and other objectives

Figure 1: Overview of FISTERA scenarios

Education and Learning as a Top-priority

Within the different scenarios, eight different application areas were elaborated upon in terms of their future development and resulting requirements with respect to IST:

- Social and family relationships;
- Leisure and recreation;
- Ageing population;
- Health;
- Cultural diversity;
- Transport and mobility;
- Learning and education;
- Social welfare and public services;
- Government.

The scenario-building activity was complemented by a European online-Delphi process. Among other findings, it underlined the outstanding importance of Education and Learning as top priority area driving the future of IST from the application side, well ahead of Government, Social Welfare and Public Services, and Cultural Diversity.

Although there was not a strong consensus resulting from the Delphi process on these matters, the main impediments for the development of IST applications were seen in social inequalities with respect to access to IST, and the lack of adequate finance for innovations. Important contributions of research were seen in the areas of development of more user-friendly systems and in the enhancement of the security of transactions and personal information.

Technology Trajectories and Disruptions: Emerging Opportunities for Europe's IST Industries

As a complementary perspective on the future of IST, FISTERA has developed a four-layered approach to monitor current and future developments in clusters and applications of information society technologies, and implemented this approach as a web-based tool. This approach distinguishes technologies and the functionalities they offer as the two 'bottom-up' layers of IST, and environments (like e.g. home, work, road) and IST-based services embedded in them as the two 'top-down' layers of IST. About 100 technologies and 120 functionalities have been identified, together with a multitude of linkages between them, as well as with the upper layers. For instance, the service of security assurance is required different environments like home, hospital, personal environment or malls/shopping, but always building on certain key functionalities like tagging, encryption or image recognition, which in turn may require a variety of individual technologies to be provided. Further detailed information can be retrieved on each entry at the four levels.

Based on this framework and expert judgments, technological trajectories up to the time horizon 2020 have been mapped, together with the interdependencies by which they are characterized across the four layers of the model. Not only technological trends have been investigated, but in particular also potential trend-breaks, i.e. disruptions in IST that can be anticipated on the basis of emerging developments in scientific research and expectations regarding the future evolution of performance parameters of current technologies.

Important disruptions are expected in the nine areas listed in Table 1. A particularly high relevance was assigned to the shift from products to services, the availability of unlimited bandwidth and intelligent terminals, the convergence of IST with other S&T areas like cognitive sciences, nanotechnology and biotechnology, and the disappearance of the computer in conjunction with the availability of embedded systems.

Disruptions	From Year
From Products to Services	Under way; main impact from 2010
Disappearance of the PC	2008-2010
Ubiquitous Seamless Connectivity	2008-2015
Changing Traffic Patters	Under way; main impact from 2010
Unlimited Bandwidth	2015
Disposable Products	2009
Autonomous Systems	2007
From Content to Packaging	2010
Virtual Infrastructures	2015

Table 1 : Possible disruptions in IST: Taken from the FISTERA Synthesis Report by Compano, R. et al. (2004):

'Attracting' the Paths of Future Developments

One of the objectives of this approach was to identify those information society technologies that will be instrumental in 'attracting' the future development path of other technologies. Six such 'attractors' could be identified out of the more then technologies and functionalities:

- Batteries;
- Embedded systems;
- Micro kernel/ad hoc protocols;
- Bandwidth;
- Storage;
- Information semantics;
- Radio propagation.

The data on these technology trajectories has been enriched by an analysis of the comparative strengths and weaknesses of European IST research using triadic patent statistics. The analysis shows that contrary to common beliefs, Europe seems to have improved significantly in several key areas of IST research like processing, and maintained its lead in well-known areas of strength like communications. To a significant extent, this development has been due to the strong performance of - in particular - some of the smaller and medium-sized Member States in Europe, notable the Nordic countries.

Apart from a great deal of interdependencies and knowledge flows between IST research in the US and Europe, the analysis also underlined the perseverance of historically built-up areas of comparative strength in research and technology.

Beware of Emerging Technological Opportunities and Bottlenecks in the Innovation System

FISTERA has highlighted that there are several new opportunities emerging in IST, either in areas of likely disruption or along the lines of established trajectories, which could be exploited if a forward-looking strategy for investment in R&D is pursued. Preference should be given to those areas, where Europe can build on its established scientific and technological strength, but investing early on in research on upcoming disruptive technologies offers the opportunity to take the lead in new areas.

Whether there will indeed be markets for these new ISTs will strongly depend on the future evolution of application areas. Beyond investment in ground-laying research, an R&D strategy that is oriented towards the user needs in these application areas thus seems to be necessary.

If Europe does not manage to be present in these emerging S&T and application areas, its IST industries are likely to face major difficulties of maintaining a competitive edge in the years to come. The uncertainties and impediments on the way towards the production and application of IST products and services in Europe are manifold.

The issue of human resources emerged as a cross-cutting concern in FISTERA. In order to maintain a competitive IST industry in Europe that is able to deliver the kinds of products and services needed to realize the solutions required in the main future application areas of IST, a highly qualified, but at the same time flexible and socially competent human resource base for research must be available in Europe. Rather than with a shortage of skilled labour, Europe is facing the problem of a mismatch of the skills needed in industry and services on the one hand, and the skills available on the labour markets on the other. In this respect, closer collaboration between industry and universities in matters of training and education are needed, but also new and more interactive settings for application-oriented research where the insights from and experiences of users are brought to bear in earlier phases of the innovation process.

The scarcity of an appropriately trained human resource base is also one of the reasons behind the current trend towards outsourcing R&D, obviously in conjunction with other factors like costs and customization to the needs of emerging markets.

Other potential impediments need to be kept in focus as well. From the societal point of view social inequalities with respect to the access to IST are seen as crucial. In economic terms, the lack of adequate finance for innovation and the ability to integrate user needs early on in the innovation process have been highlighted. Finally, the uncertainties about the technological and cost performance of future technologies make R&D investment risky.

Priorities for Research in S&T as well as in Application Areas

In thematic terms, FISTERA highlights a number of areas where research investment should be intensified in Europe in the future. The priority areas suggested are not only motivated by developments in science and technology (e.g. in some of the aforementioned areas of disruptions and attractors), but on the contrary also strongly oriented towards socio-economic needs and application areas (e.g. health, learning and education, government). This double-pronged strategy seems to be well compatible with the suggestions for IST research in the 7th Framework Programme.

Different time horizons and research approaches are suggested for S&T-driven areas and for application-driven research respectively. Application-oriented research will need to build in the future on a much stronger involvement of users of IST in experimental settings in order to benefit from their experiences. However, longer-term research on key areas of S&T is also necessary in order to maintain a broad portfolio of options for future, but uncertain application opportunities.

In order to enhance the innovative performance of Europe in both application- and S&T-driven research, a number of generic issues with respect to research and technology development need to be addressed as well. Topics like the upgrading of the human resource base and the establishment of new types of settings for conducting leading-edge application-oriented research have been highlighted as decisive areas for enhancing Europe's attractiveness as a research location and where supportive policy action at regional, national and European level would be helpful.

The starting up and growth of new IST-based firms can be reinforced by conducive and stimulating economic framework conditions, and by the removal of unnecessary administrative burdens in a European Union that is still too fragmented.

Sources and References

http://fistera.jrc.es the main project website where all reports and other information on events are available.

http://les1.man.ac.uk/PREST/fistera/ist_forum.htm the link to FISTERA's IST Futures Forum.

Cyber Trust and Crime Prevention 2018

Authors:	Jane Jackson, Foresight Directorate, Office of Science and Technology/ jane.jackson@dti.gsi.gov.uk
Sponsors:	The Home Office
Type:	A National Foresight project covering a single issue looking at the S&T and socio-economic fields that on which it has an impact and which have an impact on it
Organizer:	Foresight Directorate, Office of Science and Technology/ www.foresight.gov.uk
Duration:	March 2003 to June 2004 — Budget: € 650 000 — Time Horizon: 2018

Purpose

The aim was to take an independent and objective look at the subject of the vulnerability of ICT. Through using the best science available explore the application and implications of next-generation technologies the challenges of the foresight exercise were to:

- ***set out visions of the future, define a range of possible outcomes, identify possible drivers, opportunities and threats, barriers to progress, and models for decision-making***
- ***create networks of scientists, business people and policy makers who can act on the findings to influence the future***
- ***set out some key challenges and engaged those who can take them forward.***

The Challenge of Trust and Security in a Cyber World

The UK Foresight programme is formed of a rolling programme of focused projects. Cyber Trust and Crime Prevention was a topic suggested by a workshop of eminent scientists which then received support from UK government and academia. More generally, they realised that ICT was increasingly integral to the functioning of modern society and therefore needed to be trusted by the users and not be vulnerable to attack by crime particularly in view of the need to keep pace with the rate of development of the technology.

The objectives of the project were to:

- Explore the challenges facing policy makers, businesses and the public by the rapid development of ICT if there is to be future trust in cyber systems,
- Contribute to the framing of the debate to help ensure the UK maintains its position as a major ICT player, that new technologies can be used to create wealth and to improve the quality of life as rapidly as possible,
- Enable technology to be used to reduce crime, and
- Investigate the extent to which technology introduces new forms of crime, or extends the scope of existing crimes.

The Foresight Approach

The project was overseen by a stakeholder group chaired by a minister from the Home Office with the membership drawn from business academia and government.

The mechanics of the project were carried out through a series of workshops, firstly to define the scope of the project. The scope formed the basis for the commissioning of state of the art science reviews, which in turn fed into three sequential workshops picking up on particular themes derived from the reviews and from the outputs of the previous workshop. A sub group looked at what future technological developments were likely to occur. A period of analysis and synthesis of the results led to the development of three scenarios set in 2018. These were in turn explored in gaming seminars involving participants from the public sector, business and research communities to look back from 2018 to envisage what could be done today to make these scenarios more palatable.

Diagram 1 shows the inter-relationship between the different parts of the process.

When the project's findings were published an Action Plan was drawn up to apply the outcomes of the project and to explore the implications of the project's findings. The stakeholder group will meet in autumn 2005 to assess progress against the Action Plan.

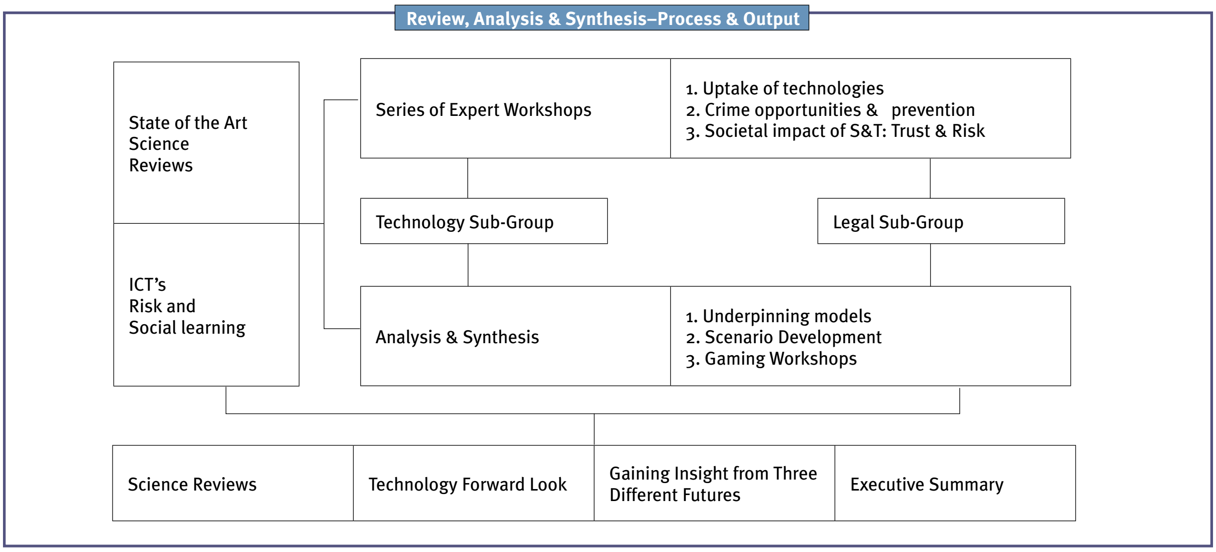


Diagram 1: A representation of the process undertaken in the Cyber Trust and Crime Prevention project

Future Visions

How the Risks May Change

We are moving steadily towards pervasive and ubiquitous computing: everything we buy and wear may be electronically tagged and connected. There will be huge data sets, intelligently mined by autonomous and intelligent software. Whilst technology will bring large benefits there will still be risks.

There will be a migration from the internet infrastructure to 'utility computing'. These services will not be confined to the home and personal digital environments, but will be created with wearable technology allowing people to be connected at any time and in any place. Applications and their content will be automatically tailored to the user.

As more systems are developed and integrated there is a risk that the complexity and hence vulnerability of the systems will increase. Vulnerability will be both in terms of risk of failure of parts of the system and more opportunities for crime.

The rapid pace of innovation and adoption of new systems makes it increasingly difficult to keep up with the new risks. This means there could be increasing incidents of spotting and reacting to new crime opportunities long after they have created the damage.

Perception of risk is a significant factor which affects whether people take advantage of the opportunities offered by the new cyber-world. Managing this is a key aspect of any response to management of future risks.

How the World Might React to the Changes in Risk

We generated three scenarios exploring how society might react to these changes. The scenarios were based on different approaches according to who takes responsibility for security and the consequent willingness to share information with others.

The three scenarios were:
- Frog Boiler: We carry on as we are indefinitely, with an unclear delineation of responsibilities across individuals, business and government and limited access to information on the activities of individuals in cyber space;
- Touch me not: Individuals do not allow others to know what they are doing but accept that they should take more responsibility for their own security;
- Knowing it all: Individuals are content to let government have more access to what they do in the digital world but in return expect business and government to police the risks.

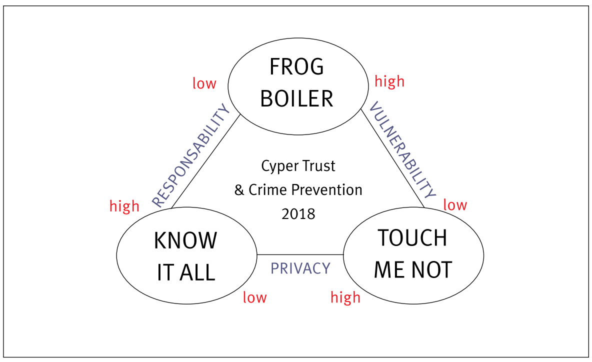


Diagram 2: The three scenarios are set on the outer edge of the future possibility space and are used as a tool to investigate the key factors that may affect cyber trust and crime prevention

What we should do now to Respond to Emerging Challenges

The project considered what might enhance the trustworthiness of complex systems in the future, what might enhance cyber trust, whether new types of criminal opportunity associated with ICT could be reduced, what were the implications for future research.

The participants of the workshops identified the following elements of a response to the emerging challenges and risks:

- **New digital forensic tools** to automatically scan for potential problems and assign provenance in an auditable way. As ICT becomes increasingly pervasive both context and data provenance will be increasingly key. As data storage increases so will the need for improved digital forensics and evidence processes.
- **New structures which allow government and business to identify and design strategies to respond to the new risks.** The challenge for the future is to be sufficiently fleet of foot to respond to the quickly changing challenges. For example, to consider the implications of developments in data-mining and autonomous agent software.
- **New language and frameworks** are required for a response which can be applied in a quick, flexible way to new challenges as they arrive. One of the delays in responding to risk is often labeling it, getting a common understanding of it and then working out how something new fits in with our current systems of risk management.
- Design-out crime but design-in usability. Although cyberspace is new, the behaviors that are important in understanding criminal opportunity are largely the same. Opportunities arise from the complexity of the technology, particularly the growing 'system of systems'.
- **Continue to build international collaboration to respond to the risks.** Cyber crime is a global issue and international cooperation will be needed to address it, with ethical principles guiding the debate. A need to improve international law enforcement cooperation and further develop international standards was identified, including harmonization of international data protection legislation.
- **Develop a stronger partnership between government and business to improve law enforcement capability.** The impact upon the legal and regulatory system needs to be explored further. There is acceptance that some personal data needs to be collected for effective law enforcement, but that there should be strong independent monitoring and audit of public sector data use.
- **Develop solutions to improve trust:** The perception of risk in cyberspace is largely based on experience, but there are a range of socio-economic variables that impact upon people's behavior. Identity, security and privacy are all factors that affect how trusting people are. Possible solutions to improve trust include better information for the user about technologies and their risks, together with dialogue between government and business.
- **Decide how we should use the quickly developing technologies for identification and authentication:** For example, initial identity enrolment must be consistent and accurate. With rapidly accumulating data there is an absolute requirement for clear provenance of information objects. Usage is not just affected by flaws in technology, but by individual behaviors and cultural differences.

The project considered what might enhance the trustworthiness of complex systems in the future, what might enhance cyber trust, whether new types of criminal opportunity associated with ICT could be reduced, what were the implications for future research.

A Clear Governance Structure

Trustworthiness has not been seen as a major issue in the development of new ICT over the last two decades, especially when compared to functionality and users generally welcomed new applications. However, some participants in the project took the view that current models of proprietary systems were at odds with modularity, stability, simplicity and open scrutiny, which were likely to become increasingly important in the future and were essential for the creation of highly trustworthy systems. In that case, the UK and EU might create competitive advantage by establishing effective standards in areas such as traceability and provenance that could then be adopted elsewhere. Without more action to reduce the impact of new vulnerabilities the risks created might be one of the biggest brakes on the deployment of new capabilities.

The gaming seminars realised that for those looking to enhance trust and the use of ICT based services, there is a need for a clear governance structure to detect and react to abuses of failures, a belief that the issues for the criminal justice systems that are raised by the need to collect and use digital evidence are sufficiently difficult that they are not capable of satisfactory resolution by 2018.

The structures for dialogue between government parties will need to evolve in the future to allow quicker feedback on identifying and responding to potential criminal opportunities. Several of the project's stakeholders will use the project's findings to explore these issues in more detail.

The main areas for future research are the social amplification of risk, criminal opportunity models, assessment of impacts on privacy, dependable software engineering and digital forensics initiatives.

Sources and References

All the above information is drawn from the Foresight Cyber Trust and Crime Prevention reports which are available at **www.foresight.gov.uk**

Nordic Hydrogen Energy Foresight 2030

Authors:	Birte Holst Joergensen/ birte.holst.joergensen@risoe.dk		
Sponsors:	Nordic Energy Research (25% of budget), Nordic Innovation Centre (25% of budget), The remaining 50% of the budget was shared by 16 other partners: Risoe National Laboratory (DK), VTT (FIN), Swedish Defence Research Agency (SE), NTNU (NO), University of Iceland (IS), AGA (SE), Vattenfall (SE), H_2 Forum (SE), Norsk Hydro (NO), Wärtsilä (FIN), ABB (FIN), Fortum (FIN), Energi E2 (DK), Danish Gas Technology Centre (DK), IRD Fuel Cells (DK) and Danish Association of Engineers (DK)		
Type:	International cross-border foresight covering the five Nordic countries and the home rule governments of Green-land, the Faroe Islands and Åland. Sector specific foresight on hydrogen and fuel cells.		
Organizer:	Risoe National Laboratory/ www.risoe.dk		
Contacts:	Birte Holst Joergensen, birte.holst.joergensen@risoe.dk Per Dannemand Andersen / per.dannemand@risoe.dk		
Duration:	January 2003 – June 2005	Budget: € 751 000	Time Horizon: 2030

Purpose

The overall aim of the Nordic Hydrogen Energy Foresight was to find long-term promising ways for Nordic stakeholders of exploiting hydrogen in the drive to meet the 3 Es: Energy Security, Economic Growth and Environmental protection. More specifically, the aim was to build a Nordic Research and Innovation Area in hydrogen and fuel cells, contributing with a bottom-up approach to the European Research Area.

Objectives and Design of the Nordic Hydrogen Energy Foresight

Following a mapping of foresight activities in the Nordic countries in 2002 (Eerola & Jørgensen, 2002), a proposal was made by various stakeholders from academia and industry to conduct a foresight on hydrogen at Nordic level. At that time, the international focus on hydrogen was at its uptake. Iceland was at the forefront in setting hydrogen on the political agenda and in the other Nordic countries there were important R&D undertaken within key hydrogen technologies. Also, the diversity among the Nordic countries as well as well established political and economic collaboration in research, innovation and energy represent some unique and interesting opportunities for exploring different pathways to the hydrogen economy. The Nordic H_2 Energy Foresight had the following objectives:

- To develop socio-technical visions for a future hydrogen economy and explore pathways to commercialization of hydrogen production, distribution, storage and utilization.
- To contribute as decision support for companies, research institutes and public authorities in order to prioritize R&D and to develop effective framework policies.
- To develop and strengthen scientific and industrial networks.

Expert Judgement and Quantitative Analysis

The Nordic H_2 Energy Foresight put equal weight on process and content, both for the intrinsic quality of the outputs of the process and for the networking and commitment it created. Therefore, the project centered on a sequence of four workshops, bringing together project partners and experts from industry, energy companies, research, and governmental authorities. Expert judgments and discussions in these workshops were assisted and challenged by formal quantitative systems analysis and technology assessment.

In order to make the management of the complex foresight process easier the Nordic H_2 Energy Foresight project was designed to consist of twelve work packages with clear deadlines and budget outlines. The preliminary document analyses (WP1) and expert interviews (WP3) were carried out in the beginning of the process to support the modeling work and systems analysis (WP4) and to prepare relevant introductory material and working procedures for the interactive workshops (WP5-8). It was also considered important to launch the project website (WP2) in an early phase of the process. The idea was to support the communication between the project partners and to provide an efficient means for disseminating relevant information to a wider public. Dissemination of information took also place in the context of international conferences (WP9). Analytic work and reporting by the project core group (WP10) was carried out between and after the workshops. An important part of this analytic work was the integration of the qualitative and quantitative results. The modeling of the Nordic hydrogen energy system proceeded in parallel with the other working packages and the analytic work continued up to the Nordic Conference where the integrated results were presented (WP11). Some feedback from the participants was collected already during the foresight process. A more profound process evaluation (WP12) was included in the end of the process.

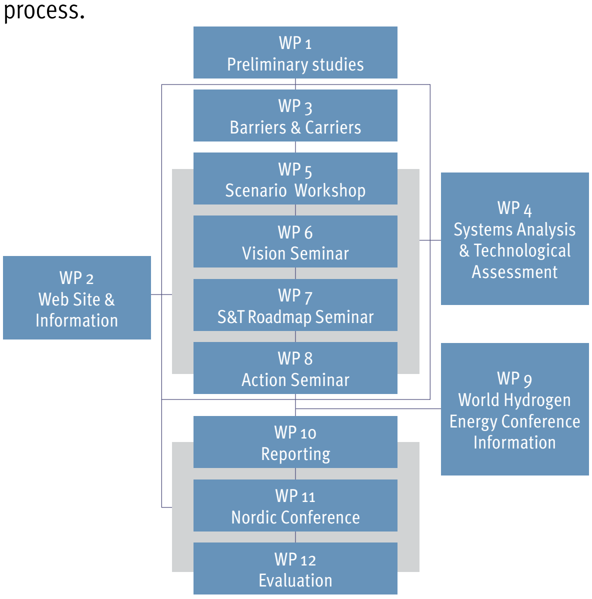


Figure 1: Project Design

Future Visions

Making the Future in Hydrogen

At the Scenario Workshop, external scenarios were developed for Nordic hydrogen energy introduction. On the basis of brainstorming and group discussions, a matrix of three first-period scenarios (2003—2015) set against three second-period scenarios (2015—30) was constructed. The general rationale for considering external scenarios is that many conditions of great importance to Nordic H2 energy introduction are beyond the control of Nordic decision-makers:

- **B – Big Business is Back** is a global economy dominated by US multinationals and US big business-oriented policy approach. Major physical investments are not particularly helped by the prevailing quarter-to-quarter capitalism. There is very little interest for global environmental issues. Oil prices are moderate. However, H2 energy is still believed to be a likely component in future energy systems.
- **E – Energy Entrepreneurs and Smart Policies** is a global economy dominated by entrepreneurs and venture capitalists, and with policy actors apt at harnessing the power of innovation for societal purposes. The energy sector is characterized by a tendency towards decentralization. There is some interest for global environmental issues. Oil prices are moderate.
- **P – Primacy of Politics** is a Europe-centric economy characterized by co-operation between governments and big business and with a great interest in large-scale investments in, for example, energy and transport systems. There is some interest for global environmental issues. Oil prices are high due to security-of-supply problems and the high oil price is an important driver for energy sector change.

The following 9 scenarios for formulated by combining these three visions with three alternative second-period developments:

- hydrocarbon security-of-supply problems,
- undisputable CO2 problems
- a smooth path to the future'.

Energy consumption in the Nordic area was divided in four main types: electricity, transport, space heating and "others". The fourth type covers use of heat energy in the industrial sector. In systems analysis and assessment of external scenarios, it was assumed that hydrogen technologies would not replace existing energy technologies in the industrial sector. Further, the share of hydrogen for stationary applications, i.e. electricity and heat production, was assumed to be approximately the half of the "big visions".

Developments 2015-30 External scenarios 2003-15	1. Hydrocarbon security -of- supply problems	2. Undisputable CO2 problems	3. A smooth path to the future
B-Big Business Is Back			B3 Big vision 6%
E-Energy Entrepreneurs and Smart Policies	E1 Big vision 15%		
Primacy of Politics		P2 Big vision 18%	

Figure 2: External Scenarios for Hydrogen (The color represents ease of Nordic H2 introduction with green, yellow and red indicating low, intermediate and high degrees of difficultly. The % refers to hydrogen's share of the total Nordic energy system in 2030 excluding industrial consumption).

The evolution of the hydrogen as an energy carrier was assumed to grow exponentially from 2005 to 2030 and after 2030 a transient period was assumed up to 2050. Hydrogen is not an energy source in itself, but is produced from a basic source of energy. For the Nordic countries as well for the rest of Europe, the main energy source for hydrogen production over the next 25 years will be natural gas - especially in the B3 scenario. In the two other scenarios, natural gas might play a smaller but still important role. Renewable energy sources will provide most of the rest. The energy sources for hydrogen production in the three scenarios were settled by 2030 to:

	Natural Gas	Renewables (or nuclear)
Scenario B3	70%	30%
Scenario E1 & P2	50%	50%

Table 1: Sources for Hydrogen Production

Identifying the Most Feasible Routes to the Hydrogen Economy

Through a participative roadmap exercise the sequence of implementation and the inter-dependence of the hydrogen technology visions from today and until 2030 were roughly outlined. Furthermore, business opportunities for Nordic equipment industry and energy market opportunities for the energy companies in the Nordic countries were identified in three areas:

- **Hydrogen Production and Transmission:** According to the model calculations, steam reforming and biomass gasification seem to be the most competitive technologies for hydrogen. With the scenario assumptions, the needed capacity (MW H_2 out from production units) of steam-reforming, biomass gasification and electrolysis units in 2030 were 1200-12000 MW, 1300-4000 MW, and 400-1300 MW, respectively. The approximated Nordic market sizes in 2030 for the base scenarios were € 1-3B for hydrogen production, and from € 4-12B for hydrogen transmission.
- **Stationary Use:** Niche applications of hydrogen/fuel cell based APU (Auxiliary Power Unit) and UPS (Uninterruptible Power Supply) form some of the first steps on the road. Both hydrogen and natural gas driven fuel cells for domestic and decentralized CHP (combined heat and power production) are seen as important steps towards the hydrogen economy in the Nordic countries. In the longer term, hydrogen driven CHP must be implemented in large-scale to arrive at the visions for 2030. In the scenario calculations, FC CHPs seem to be the most competitive for heat and power production in the long-term. The heat and power production with hydrogen fuelled fuel cells in 2030 is 2200-6700 MW, while with gas engines the maximum energy production capacity is 200-300 MW only. The Nordic market sizes in 2030 for the base scenarios were €1-4B for stationary applications.
- **Transport:** Introduction of hydrogen in the Nordic transport sector will follow the same paths as in the rest of Europe. The first steps will be special vehicles, busses and fleets. A special Nordic issue might be the use of hydrogen in the marine sector. Another Nordic niche might be special vehicles where H_2/FC systems can improve the functionality of these vehicles. In 2020, about 1-4 million hydrogen vehicles and in 2030 about 3-8 million hydrogen vehicles are needed to fulfill the 'big visions' for hydrogen energy in the Nordic transport sector. The number of fuelling stations needed in 2020 was estimated to 1000-4000 and in 2030 to 3000-8000, respectively. These scenarios for hydrogen supply per station were based on the assumption that 50% of the vehicles were powered by an internal combustion engine and 50% equipped with a fuel cell drive train.

Towards the Nordic Innovation and Research Area in Hydrogen

Nordic H_2 Energy Foresight identified a number of Nordic business opportunities within industrial equipment and energy markets services. The suggested Nordic action strategy is formulated to promote these opportunities.

Business Opportunities

A range of business opportunities for identified in both equipment and energy markets. These were characterized in three main categories:

- Production and transmission of hydrogen,
- Use of hydrogen in the transport sector,
- Stationary use of hydrogen for power and heat.

Sources and References

All the above information is drawn from the Foresight Cyber Trust and Crime Prevention reports which are available at **www.foresight.gov.uk**

Greek National Technology Foresight 2021

Authors:	Tonia Damvakeraki of Atlantis Consulting S.A. / damvakeraki@atlantisresearch.gr		
Sponsors:	Ministry of Development – General Secretariat for Research and Technology		
Type:	National technology Foresight covering scientific as well as socio-economic fields		
Organizer:	The General Secretariat for Research and Technology/ www.foresight-gsrt.gr, Contact Nikos Konstantopoulos/ nkon@gsrt.gr		
Duration:	2001 to 2003	Budget: € 1.5M	Time Horizon: 2015-2021

Purpose

The National Foresight Programme in Greece mainly focused on exploring the future of the Greek economy and society and the potential role of science, research and technology in shaping the future in terms of the development of a knowledge society.

Motivation and Implementation

Context of the Exercise

The National Foresight Programme in Greece was implemented in the framework of the Operational Plan for Competitiveness (Community Support Framework 2000-2006) and was co-funded by 75% from the European Union (European Regional Development Fund) and 25% by the Greek Public Sector. The programme was undertaken in order to explore new strategic methods for the decision making that will promote the development and competitiveness of the country within an Enlarged Europe – time horizon: 2015 &2021.

Objectives

The main aim of the project is to develop a set of key guidelines to assist the government in the policy design and decision-making process and the enterprises in improving the planning of their strategy. The main objective is the creation of a potential Foresight centre for exploiting the know-how and promoting further foresight activities in Greece.

Methods

Although the national foresight programme utilised a combination of techniques and emphasised on dialogue and interaction it was mainly based on the scenario building method; this means that scenarios were built through processing information bibliographical review, etc. Scenario building was selected as it allows the development of 'potential worlds' where specific actions and activities as well as social leaders are identified. The main focus for the development of these worlds was not the past experiences, but the utilisation of imagination and creativity; furthermore, the most important issues examined for the production of scenarios were research, science and technology.

At Macro level, the Monitoring Team for the project developed some original scenarios that were further developed by the Working Groups utilising a bottom-down approach. These scenarios examined the potential future developments for Europe and Greece.

At micro-level the analysis was mainly focused on 11 thematic areas corresponding to different sectors and technologies. The micro-scenarios were more detailed and specific, examining strategies and policies for the development of science, technology and innovation priorities for each thematic area. At the same time, the micro-scenarios also examined the potential realisation of the macro (general) scenarios as well as the potential versions of "future worlds" depending on the progress of these specific areas.

The specific thematic areas were:
- Biotechnology,
- Defence Technologies,
- Tourism &Culture,
- Energy,
- Environment,
- Health and Quality of Life,
- Industrial Production and Manufacture,
- Materials,
- Information and Communication Technologies,
- Transport,
- Agricultural Development and Fisheries.

While there were also 5 horizontal actions examined:

- Funding,
- Human Resources & Training,
- Territorial Distribution,
- Innovation,
- Social Engagement with Science, Technology and Innovation.

The overall management of the exercise was handled by a monitoring team, which developed a "start-up document" for the beginning of the work. They also provided guidelines and organised the meetings between the working groups. These were supported by support teams made up of representatives of various organisations, social groups, professional associations, and other people with experience in the area of each working group. Each working group provided the synthesis of the results from their analysis and the monitoring team was responsible for synthesising them all in the final report.

Identified Socio-Economic or Cultural Trends and Trend-Breaks

The most important socio-economic trends identified within the exercise are the following:

- Globalisation and the changing determinants of economic growth (in terms of economic challenges, trends and impacts and certain weaknesses were identified concerning the extent to which the specific country exploited globalisation of markets).
- The issue of Brain drain and the ability of small countries to absorb the high level human resources (scientists and researchers) that could make a difference in their fields.
- Ageing population- Fewer children per family-worsening work-life balance.
- Economy structure, R&D intensity, and R&D and innovation activities of firms (turning from "traditional economies" into more knowledge intensive ones).
- Quality of human capital (employment and promotion of training for attaining high level skills and addressing the emerging market needs).
- Quality of social capital (promotion of collaboration with non profit and non governmental organisations, development of synergies with social partners).
- The creation of an Information Society and becoming leaders in the sectors developing synergies with other fields (e.g. biotechnology, nanotechnology).
- The creation of a Knowledge Society (social and organisational learning, new forms of work, etc).
- Social cohesion and exclusion (economic immigration, regional disparities, geographical seclusion, etc).
- Changing consumer behaviour and attitudes (changing needs, need for improved qol, improved products, customer satisfaction organisations, etc).
- Environmental and Energy Resources (changing environment, fears for the future of the planet, fear for the lack of energy resources, hope through the use of RES and new applications, etc).
- Health and Welfare (changing work-life balance, need for better health care systems, need for better quality in the Health care sector, changes in the welfare systems, etc).

The Set of Technological and Sectoral Trends or Trend-breaks that are anticipated in the Foresight Programme

The technological and sectoral trends are not presented in a synthesis but per thematic area examined by the working groups. The main findings are the following:

- ICT: low level of 'digitalisation' in comparison to the EU average; promotion of 'technology pull' instead of 'technology push' mechanisms for the development of new technologies; development of synergies with other emerging technologies such as Biotechnology and Nanotechnology that might lead to new hybrid technologies (e.g. bio-informatics, info-nano, etc).
  Biotechnology: Emerging issues:
- Greek people against GMOs but aware of the consequences.
- A lack of information on behalf of special scientists.
- A need for collaboration between social stakeholders.
- Materials: sustainable development; new technologies; interaction with other sectors (ICT, biotechnology, environment, energy, agriculture, industry, transport, tourism, culture, health, defence, etc).
- Energy: Energy wisdom; rational use of energy; promotion of RES and RES technologies; energy logistics; energy policy; energy consciousness; improvement of the energy demand.
- Agricultural Development: the main objective of 'Agricultural Development' is to achieve sustainable development through the development and interaction of the countryside and agriculture. By 2021 about 5-10% of the population will be occupied in the agricultural sector.
- Industrial Production and Manufacturing: strategic role of manufacturing industry; transition from the industrial economy to the knowledge based economy; production of added value; uncertainty of industrial future.
- Tourism: Sustainable tourism; promotion of alternative forms of tourisms; multiple services offered; utilisation of available resources.
- Transport: the vision for 2021 is to achieve Sustainable Mobility pertaining high quality of services, safe transportation, protection of the environment, sustainable energy use, new forms of business, integration of innovation and social acceptance.
- Defence technologies: the national defence sector can contribute to the Greek version of the Knowledge

Economy and Society by 2021 through two mechanisms:
- Directly through technological change.
- Indirectly by utilising part of the resources for other applications of strategic national importance.
- Health and Quality of Life: Health technologies will lead the way in a national system for promoting quality of life. This will include nutrition, health and safety at work, life styles, tourism of the knowledge society, culture, new governance – emphasising in the Greek and Mediterranean special characteristics.
- Environment: Environmental protection, environmental technologies, clean technologies, promotion of eco-economy that will play a major part in the structure of the national economy and the GDP (develop and export eco-technologies abroad).
- Culture: New cultural technologies through synergies with new technologies and creation of 'hybrids', new reformed cultural industry in Greece.
- Governance and e-Governance: Emerging issue of synergies with the 'new technologies' (e.g. biotechnology), implementation within strategic sectors (Tourism, Health and Quality of Life etc.).

Opportunities and Challenges that Might Arise from the Trends and Trend-breaks

The development of the macro and micro scenarios and the integration of the results of the various thematic areas working groups in them provide a list of potential opportunities and threats, challenges and weakness. The main focus though is in the promotion of R&D and innovation in all identified emerging sectors/ technologies in order to achieve sustainable development and create a knowledge-based society.

Key Issues-Raised of Particular Relevance for Policy

The main issue arising for policy making concerns the funding of Research and Technological Development. This whole issue is playing a crucial role for the Technological Change, especially when seen for a time horizon of 20 years. Especially for the case of Greece this is very important since we have set as an objective the doubling of the % of R&D in the National GDP (from 0.7% in 2001 to 1.5% in 2010). Furthermore, we also have to achieve the 'European' objectives of Lisbon and Barcelona (3% target) for 2020 while we know already how hard this will be to achieve.

The Solutions and Adaptations that will be Required to Tackle Challenges and Benefit from Opportunities

Some potential solutions for helping increase the funding for R&D are the following:
- Increase of public funding for R&D
- Increase of private funding for R&D (from enterprises that are already involved in R&D activities)
- Promoting the entrance of 'new players' by increasing their funding; this could include public sector (funding the R&D activities of Ministries and organisations) as well as private (promotion of research culture in already existing units, creation of new units supporting innovation, and development of new sectors)
- Seeking for new sources of funding, at international level (FDI, initiatives for attracting International R&D units in the country), but also at national level (new forms of funding, new initiatives, involvement of NGOs and other social organisations).

Identified Priorities and Focus for Action

The structure of the R&D and Innovation system must be transformed in order to promote the most emerging scientific and technological sectors - and in order to become more competitive within the EU.

Identified critical factors and key players in shaping the future

It is crucial to include all key players in the process for the shaping of the future and promoting R&D and Innovation through new technologies. This means that apart from the government, the policy makers, and other political parties, also the science and research community should be included as well as professional associations' representatives, NGOs representatives, citizens' organisations, etc.

Sources and References

- www.gsrt.gr

Green Technological Foresight on Environmentally Friendly Agriculture 2024

Authors:	Kristian Borch, Risø National Laboratory / Kristian.borch@risoe.dk		
Sponsors:	Danish Forest and Nature Agency, Ministry of the Environment		
Type:	A national foresight exercise focusing on technologies to manage the impact of agriculture on the environment and landscapes		
Organizer:	Risø National Laboratory, Roskilde, Denmark/ www.risoe.dk		
Contact	Kristian Borch/ Kristian.borch@risoe.dk		
Duration:	9 months from 2003 to 2004	Budget: € 94 000	Time Horizon:2014-2024

Purpose

The purpose has been to thoroughly examine those environmental challenges which agriculture will face in the future - and make policy recommendations on the efforts required to develop and promote technological and structural solutions that can minimize the environmental impact of agricultural production on the surroundings, improve animal welfare and provide new methods and products for agriculture.

Green Technological Foresight Initiative

The Ministry of Science, Technology and Innovation was endowed with funds to carry out a Technological Foresight (TF) project during a three-year period (from 2001 to 2004). The plan was to complete approximately eight foresights during this period. One of these foresights was focused on green technologies in general. Agriculture was identified as sector with major impact on the environment, and a sector where new technologies could ease the environmental strain. The Green Technological Foresight on Environmental Friendly Agriculture was a spin off adopted by the Ministry of Environment.

Recommendations for innovation policies considering more environmental friendly agriculture

The objective has been to make a catalogue of promising green agricultural technologies and how to promote them. The process was designed as a number of workshops where stakeholders gave input to an expert group. A professional facilitator helped the communication between stakeholders and experts.
Stakeholder workshops, roadmaps to communicate main trends, and a – rather unsuccessful – Delphi with only a few respondents were used as methods in this foresight project. Stakeholders where recruited continuously through nominations by those persons already involved in the project.

The exercise was organised with a steering group of 4 persons involving 3 ministries and the project leader. It was chaired by a scientific officer from the Forest and Nature Agency. An expert group of 5 persons including the project leader, authored the working documents and the final report.

The management of the foresight exercises coordinated a loosely coupled system with focus on the following functions:

- Motivation factors based on visions on the project objectives.
- Communication in the planning with appropriate intermediate aims that can function as guideline in the following project process.
- Pro-active leadership during the implementation of the project securing exploration of new possibilities that may appear during the project.

Knowledge Based Agriculture

Future farming will orientate and base itself on knowledge and co-operation between farmers, research institutions and authorities. The aim of this co-operation is to create a dynamic and long-term farming policy that can secure that Danish agricultural products are competitive on the world marked, without negative consequences for the environment and the nature landscapes. In the foresight there was a general agreement that while agriculture would have even less importance for the Danish GDP in the future, the importance of the sector would be significant for product innovation in the food industry in general and as manager of nature and landscapes.

Seven Recommendations on Future Environmental Friendly Technologies in Agriculture

According to the foresight exercise, future agricultural systems will be based on the following technologies that have the potential to contribute to future environmental friendly agriculture:

- Plant Gene Technology is controversial, but a well-considered application can result in increased and environmental benign production as well as preserve landscape and nature values.
- Information and Communication Technology (ICT) includes both decision support systems and a more efficient communication of the latest knowledge about environmentally friendly farming production. The technology does at the same time give completely new possibilities for supervising, modeling and controlling biological environments.
- Manure Technologies include knowledge and techniques to handle manure as fertilizer from stable to plants aiming at reduced leaching to the environment.
- Biomass Technology consists of technologies that can effectively and cheaply convert biomass into energy and material of high quality.
- Cultivation and soil preparation implies intelligent utilisation of biological and agricultural knowledge and is an effective strategy to minimise environmental impact from agriculture. In short: 'good agricultural practice' based on expert systems and ICT.
- Precision Farming uses GPS, GIS, sensors and robots to precisely adjust and eventually avoid the use of fertilizer, pesticides, etc., based on knowledge about variations in conditions of cultivation or environmental fragile areas.
- New Stable Systems focusing on low emission of odour and ammonium by means of stable design, new surface materials, feeding, ventilation, and chemical or biological absorption of odour and ammonium.

Potential for Systems Export on Green Technologies

The consideration to the environment and the development of farming and nature-related values as well as optimal utilisation of resources could be seen as a basis for being able to compete internationally for farming products. The reason being that even though the international market will not immediately pay for investments into Danish environment, landscape and nature-related values, there is great potential for exporting the environmental technology to the international agricultural sector. A green image is at the same time a good sales argument at several more markets.

Future Agricultural Technologies will Create a Balance on Three Bottom Lines

The conclusion of the foresight is that the future of agriculture, whether it is intensive (industry-based) or extensive (organic-based), has to be holistic and it will be based on knowledge and co-operation between agriculture, research institutions and authorities. This is to secure a dynamic and long-term agricultural policy can be created, which will integrate consideration for the environment.

When the technologies of the future environmentally benign agriculture are assessed and selected, it will take place in relation to their contribution to three areas. This is known as 'The Agricultural Triple Bottom Line' (see Figure below).

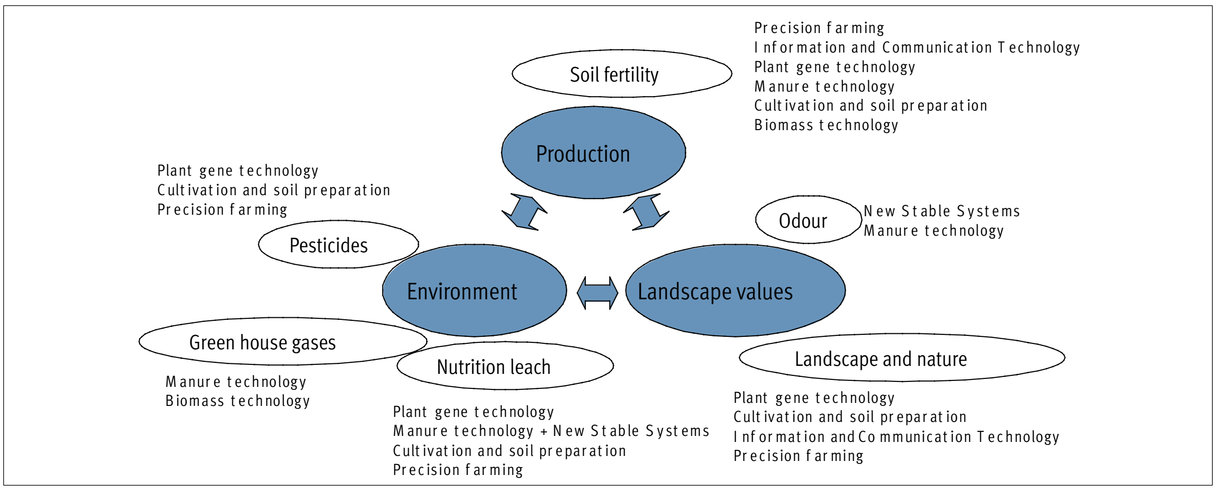


Figure - The Agricultural Triple Bottom Line: The figure demonstrates how the three bottom lines – production, environment, and landscape and nature values – constitute a unity when green technologies are selected for future agricultural systems

The three bottom lines are:

- Production: The industry must be able to maintain a profitable and healthy plant and animal production. This is achieved by placing weight on technologies that ensure the soil's fertility, give operational economical advantages, ensure an improved quality of nutrition and feedstuff and include energy crops and non-food crops.
- Environment: The agricultures' activities must be able to be carried out without negative consequences for the environmental physical frames, including space, water and air that that can be influenced by wastage from agricultural production.
- Landscape and Nature-Related Values: Agriculture needs to be part of managing and creating beautiful landscapes, a versatile nature with many high quality habitats for wild flowers and animals, clean drinking water and recreational values.

A Variety of New Agricultural Concepts

Different agricultural concepts will utilise the technologies differently. Two tracks of agricultural concepts will mutually challenge one another in the future:

- In industrial-based agriculture we speak about intensive commercial enterprise, where technologies first and foremost are utilized with a view to production yield and effective environmental solutions.
- In the organic-based agriculture the technologies are assessed in proportion to three central principles —precaution, re-circulation and subsidiarity.

	Industrially Oriented Production	Organic Oriented Production
Genetic Technologies	Total use of GMO's and crossing of arts boundaries	Limited to the utilisation of bio- markers in traditional processing
Bio-Energy Technologies	Straw and energy crops for centralized power stations, ethanol and rme factories	Domestic animal fertilizer and N-fixing energy crops for decentralized bio-gas and thermal gasification
Automation	Milking robots in the stable	Milking robots in the field

Table: An illustration of future uses of green technologies within the two generic production paradigms that can be envisaged for Danish farming.

New technologies can be utilized in both forms of farming with a view to lessening the environmental effect. However, there can be a difference in how the technologies are used as the examples show in the table. The technologies within organic farming are assessed in accordance with three principles: cautionary, re-circulation and subsidiary. Certain technologies, such as genetic engineering, are completely rejected by the organic farming whilst diverted techniques can be used to improve organic crop processing.

Green Technologies – Inside and Outside Agriculture

Green technologies alone are not enough to make agriculture environmentally sustainable. According to the results of this foresight exercise, education and the introduction of new concepts are needed to promote green technologies in the food industry. After all, agricultural production is just the first link in the food production chain. At the other end of this chain, retail and wholesale will have an important role in communicating consumer preferences down stream.

In order for future green technologies to have the maximum impact on the agricultural sector greater collaboration between the Ministry of Food, Agriculture and Fisheries, the Ministry of the Environment will be required.

Considering that the agricultural sector will become a net producer of energy the Ministry of Transport and Energy should also be involved. The reason is that the major potential synergies between the recommended technologies can be achieved if a systemic and holistic approach governs innovation policy. Finally an infrastructure that can support energy production from biomass will need to be developed. Steps to investigate how manure technologies can be promoted to reduce nitrogen pollution and odur from pigmeat production have been made by the Ministry for the Environment.

Sources and References

'Green Technological Foresight on Environmental Friendly Agriculture' the executive summery is available at www.risoe.dk/rispubl/SYS/ris-r-1512.htm

Universities and the City-Region as a 'Knowledge Capital' 2008

Authors:	Luke Georghiou, PREST, MBS, University of Manchester / Luke.Georghiou@manchester.ac.uk		
Sponsors:	Manchester Science Park Ltd.		
Type:	A regional foresight exercise looking at how universities in the Manchester City-Region could contribute to its development as a Knowledge Capital with an economy founded on science and the creative sector		
Organizer:	PREST, University of Manchester. Contact: Luke.Georghiou@manchester.ac.uk		
Duration:	January to August 2003	Budget: € 20 000	Time Horizon: 2003-2008

Purpose

The goal was to engage high profile regional decision-makers in developing a shared vision of the future of business-university link-ages in the city region of Manchester. The aim was to link the strategies of the universities in the area with the City's own self-vision of its future as a 'Knowledge Capital'. The shared vision would be a scenario of what success in this area would look like in five years time and the actions required to get there.

Context

The origin of this foresight exercise lay in a strategic review of Manchester Science Park (MSP) carried out in 2003. The Science Park hosts about 80 companies and is jointly owned by the City Council, the universities whose campuses it adjoins and five private sector companies. Though run as a company it reinvests all of its profits to enhance the economic and technological wealth of Manchester. At the same time the City had produced a prospectus that embodied a future vision seeking to capitalize on its concentration of higher education institutions and its cultural and leisure facilities to form a renaissance–like combination of assets. A major national study of university–industry linkages, known as the Lambert Review, was also under way. The two most research intensive universi-ties were in the process of a merger which would form the UK's largest. As a result of the strategic review MSP agreed to sponsor a scenario workshop in order to play a more proac-tive role both in the development of linkages with universities and in terms of local and regional policy-making.

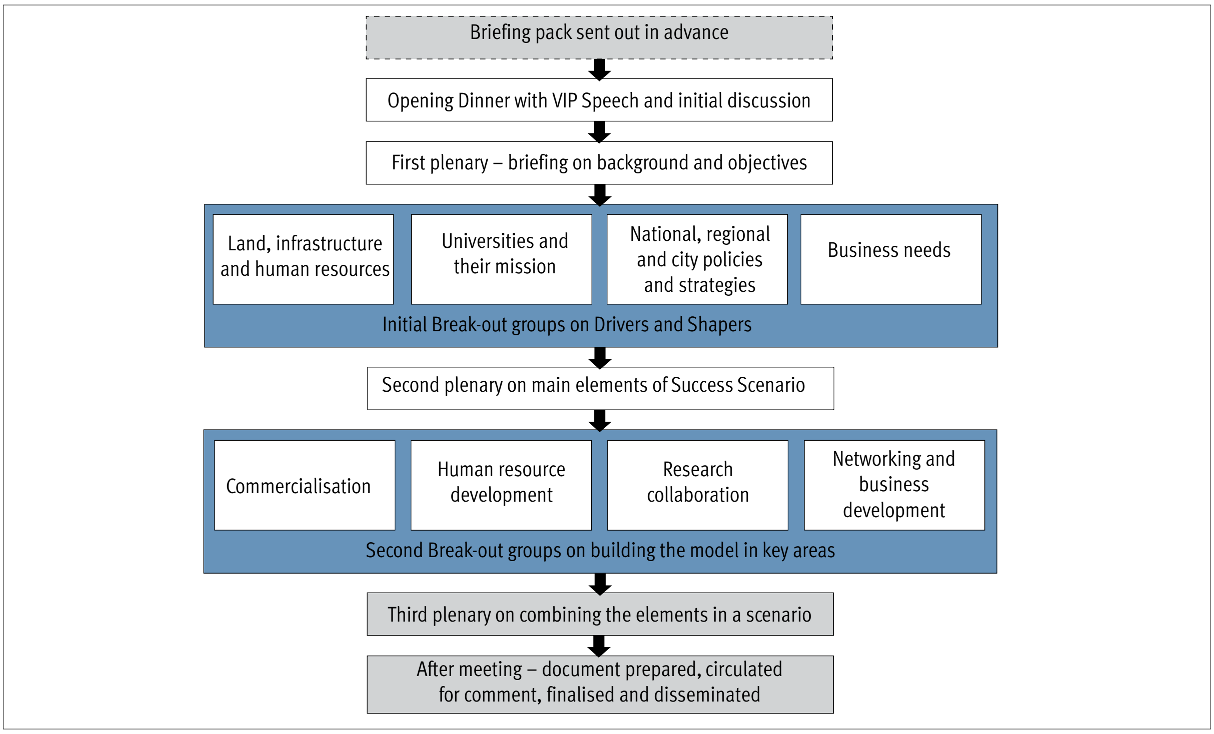
The two objectives of the exercise were:

- To develop a shared vision of the future of business–university linkages in the city region of Manchester. The aim was to link the strategies of the universities in the area with the city's own self–vision of its future as a 'Knowledge Capital'.
- To move towards a shared vision among senior stakeholders such as local political leaders, heads of universities, heads of key intermediaries and industry associations, of what success in this area would look like in five years time and to begin the process of developing a road map to get there.

An action based approach

The Success Scenario Workshop used was an action based approach, with the shared vision among senior stakeholders of what success in the area would look like being specified in terms of goals and indicators which began the process of developing a roadmap to get there. The discussion and debate involved develops mutual understanding and a common plat-form of knowledge that helps to align the actors for action. For the Manchester exercise, a five-year horizon was chosen for this exercise, to get beyond short-term considerations but to allow immediate actions to follow and to mark the halfway point in the 10-year vision of the Knowledge Capital.

The overall design of the process is shown in the following deaigram. It was based on three plenary sessions, interspersed with two rounds of facilitated break-out groups (the first on regional drivers and the second on modes of linkage), articulating elements of the scenario. Initially a list was compiled of key individuals who could be seen as shaping and driving the future of business–university links in Manchester. These came from business and commerce, national, regional and local government, intermediary organisations and the city's four universities.



Manchester as a hotspot of knowledge production and inward investment

The drivers were in themselves a part of the outcome. For example in the first set business needs represented the demand side and issues such as the balance between individual customised collaboration and collective frameworks were explored in the light of changing needs. In considering universities and their mission, the relative positioning of a range of institutions between vocational training and researchled missions was considered. Land, infrastructure and human resources encompassed the ingredients from which a strategy could be resourced, with concerns raised about the ability to supply sufficient graduates, especially with entrepreneurial skills. Finally, the influences from and tensions involved in multi–level governance (European, national, regional and city) were considered.

The areas for development were structured by considering four modes of collaboration. Commercialization of knowledge developed in universities is concerned with founding new firms or licensing knowledge to existing ones. In this area the main incentives for universities are contributing to the community, attracting good staff and providing the conditions for educating students in entrepreneurship. For the broader benefit of the national and regional economy it was seen as vital that a high-quality supporting infrastructure exists for young and growing firms. For most companies the most visible and immediately valued contribution of universities is human re-source development, including the supply of trained graduates and the knowledge transfer that comes with them. The key in this area was agreed to be in maintaining the quality of the intake, especially in science and engineering, and then in channeling graduates into productive careers.

Research collaboration normally means a company either directly sponsors research in a university or else works within the framework of a government sponsored collaborative programme. In either case the payoff for the company is access to new knowledge in the context of an area of its interest, and access to skills and capabilities it does not possess itself. For universities the benefits include additional income and contact with real-life problems and in some cases company facilities. Barriers to successful collaboration include mismatched expectations about timescales and research directions, ownership of intellectual property and lack of an adequate interface to identify and manage collaborations.

Networking and Business Development includes a wide variety of personal and institutional contacts, formal and informal, many of which represent the only channel to the vast population of existing firms with knowledge deficits. Providing an interface for such activities and incentives for academics to take part both represent important challenges.

In synthesising these issues and trends, the key elements of the success scenario for 2008 were expressed in five dimensions:

- Infrastructure: The Reach of the Knowledge Producers

Spreads to All Parts of the City–Region: A network of hotspots of university–industry interfaces has spread away from the campuses across the city-region. Entrepreneurs are attracted by the combination of café culture and easily located specialized spaces for innovation. The Manchester Science Park brand defines the quality level.

- Human Resources: Manchester becomes a Net Importer of Graduates: An exodus of graduates to Southeast England has been reversed as high quality jobs in small entrepreneurial firms attract the best. Rising teaching quality has pervaded the entire Manchester education system with mentoring one of its hallmarks. Highly qualified and entrepreneurial immigrants are actively sought.
- University Missions: Each Manchester University is recognized as World Class in Terms of its Mission: Following the emergence of the new University of Manchester as a world-class research-driven institution, Manchester's other two universities achieved similar levels of excel-lence within the context of their own missions. All three treat reach out as an integral activity but approach it with distinctive and complementary styles.
- Inward Investment: Integrated Policies Attracting Massive Investment by Multinationals and Entrepreneurs: Integrated packages combining land-use, infrastructure and academic linkages have attracted huge investments by multinationals in the region, providing a natural market for start-up firms. Regional resources are used to gear and attract national and European investment.
- Networking: Firms of All Sizes and Ages in Manchester Sourcing Knowledge and People and Meeting Development Needs from the Universities: Networking is seen as the key to businesses understanding how universities can help them. Much better interfaces now allow medium-sized firms to work with academics, while business joins city government in securing and supporting centers of excellence.

Ten key actions for policy makers

The advice to policymakers (the senior stakeholders mentioned above) emerging from this foresight exercise was encapsulated in ten key actions:

- Target and build-up centers of excellence in universities.
- Bring business and HEI cultures closer by ensuring that business and academic leaders network and that this is matched by networking at middle rank.
- The universities should develop concerted strategy for interacting with business networks and helping to create new ones where they do not exist. They should also be prepared to drop those that have outlived their purpose.
- The City-Regional Development Agency along with businesses and universities should consider mapping and evaluating their networks as first step to broader proactive strategy. More systematic use made of existing networks to get access to prime movers and shakers nationally and worldwide.
- Universities provide physical space for networks at their entrepreneurial interfaces such as incubators.
- Engage locally based business education in developing leaders and managers equipped to work in networked knowledge capital.
- Engage business in mentoring university staff in terms of understanding the business environment.
- Focus on a knowledge-based inward investment strategy
- Promote the 'Knowledge Capital'.
- Foster a 'can-do' culture.

Taking advantage of the changing dynamics

The exercise was successful in highlighting the issues raised and in putting them on an action agenda. It was reported in national as well as regional journals and the City Council agency responsible for Knowledge Capital adopted its recommendations as a checklist for agenda for action and more recently as an input to metrics of progress. Individual participating bodies have also taken up relevant points and there is already evidence of resulting actions. The exercise was effective in highlighting to senior policy-makers and stakeholders the effectiveness of 'organized' networking within the context of a workshop however short the exercise, as a stimulus for sharing, dovetailing and implementing individual visions. The contacts, ideas, networks, links, visions, scenarios and actions generated through the exercise cannot be fully tracked or exploited for reasons of timing and establishing attribution. However, a key impact has been the perception on the part of the workshop participants of the potential for capitalizing on these outputs by:

- Taking advantage of the current and future changing dynamics in the national, regional and local innovation system as policies and strategies are under review and open to change. The Lambert Review, the Knowledge Capital initiative and the merging of the Universities are three current drivers of change, opening up enhanced opportunities for new initiatives for shared visions or even alternative policy nuances to encourage more joined-up policies between national–regional–local levels.
- Moving towards the smart-linking of regional, city and university 'knowledge' strategies in key areas of overlap of missions and responsibilities.
- Drawing on the relevance, applicability and adaptability of foresight approaches in different innovation policy contexts for synchronizing visions, dovetailing strategies and kick-starting collaborative implementing actions.

What other regions can learn

Broader implications for other regions across Europe lie both in the method and the outcome. For the method the conclusion is that a 24-hour workshop can be effective if the senior stakeholders are fully engaged and supported by preparatory material and briefing. Also, substantial effort was put into producing a user-friendly report with a design concept embodying the original objectives. From the perspective of out-come many of the policy recommendations are in general transferable, though of course with context specific adaptation.

The use of foresight to produce a unified regional vision is a helpful approach to developing university–industry links in a knowledge economy.

Sources and References

- L. Georghiou and J. Cassingena Harper, Contribution of universities to the knowledge capital —a scenario for success in 2008, PREST,
- J. Cassingena Harper, Improving links between tenant companies and higher education institutions: exploring emerging scenarios for Manchester Science Park, http://www.mbs.ac.uk/research/centres/engineering-policy/publications/reports.htm, 2003
- Manchester: Knowledge Capital, www.manchesterknowledge.com
- J. Cassingena Harper and L. Georghiou, Foresight in Innovation Policy: Shared Visions for a Science Park and Business–University Links in a City Region, Technology Analysis & Strategic Management Vol. 12, No. 2, 147–160, June 2005

Production Chains 2016 – The Brazilian Technology Foresight Programme

Authors:	Rafael Popper, PREST – The University of Manchester/ Rafael.Popper@man.ac.uk		
Sponsors:	The Brazilian Ministry of Development, Industry and Trade (MDIC) The United Nations Industrial Development Organisation (UNIDO)		
Type:	A national technology foresight programme focused on the future of production chains in four key industry sctors: Construction, Textiles & Garments, Plastics, Wood and Furniture.		
Organizer:	The MDIC of Brazil - Ministry of Development, Industry and Trade. Contact Carlos Manuel Pedroso Neves Cristo at Carlos.Cristo@desenvolvimento.gov.br UNIDO – The United Nations Industrial Development Organisation. Contact Ricardo Seidl da Fonseca at R.Seidl-da-Fonseca@unido.org		
Duration:	Phase 1: 1999-2003 / Phase 2: 2004 +	Budget: € 245 000	Time Horizon: 2016

Context

The main objectives of the Brazilian Technology Foresight Programme or BTFP are to increase the competitiveness of economic stakeholders in specific industry sectors and to provide relevant information to public sector actors involved in the formulation of technology policy. The first phase of the BTFP focused on production chains in four key industry sectors – construction, textiles and garments, plastics, wood and furniture. This work is now finished and dissemination has begun. The initiative is notable for its use of methods to understand the structure of production chains, critical performance factors for the future and emerging key technologies.

A Mezzo-Economic Perspective

In 1999 the Brazilian government launched two initiatives to support national long-term STI planning. The first initiative - PROSPECTAR, was established by the Ministry of Science and Technology. It examined macro-level STI issues in order to detect important technological trends and inform government and industry of their possible impact. The second initiative and the subject of this brief, is the Brazilian Technology Foresight Programme or BTFP. It is located in the MDIC - Ministry of Development, Industry and Trade. It is a more pragmatic programme, focused on productive chains in key industrial sectors of the country. The first phase of the BTFP focused on four main sectors of importance for the Brazilian economy - construction, textiles & garment manufacture, plastics, wood and furniture. These sectors were selected on the basis of input from the Brazilian Forum for Competitiveness – Avança Brasil – on the basis of their potential contribution to employment, wealth creation, export growth as well as techno-logical & regional development. Work on the wood and furni-ture sector is not yet completed and so this brief deals mainly with the first 3 sectors. The application of foresight to produc-tion chains in a sector involves:

- Describing the production chain,
- Analyzing it's institutional and organizational environment,
- Identifying the needs and aspirations of the production chain partners,
- Analyzing their performance and identifying critical factors,
- Forecasting the behavior of critical factors and visualizing the future performance.

This method comprises two main elements:

- **Diagnostic** tools that consist of desk research and interviews with key stakeholders such as industrialists, researchers, government officials, and individuals involved in the various segments of the production chain,
- **Prognostic** tools that consist of a flexible combination of various foresight techniques.

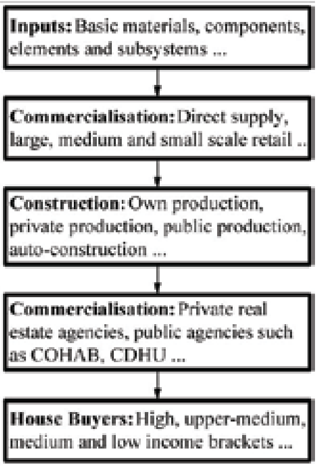
Although each sectoral exercise employed the Delphi method each adopted its own mixture of support methods.

Sector	Support Methods
Construction	Critical Factor Analysis Scenario Analysis
Textiles and Garments	Brainstorming Critical Factor Analysis Cross-impact analysis Key Technology Analysis Scenario Analysis
Plastics	Brainstorming Critical Factor Analysis
Wood and Furniture	Critical Factor Analysis Scenario Analysis

Foresight on Production Chains

Construction

The construction exercise focused on the development and commercialization of urban housing. The production chain was considered as being comprised of five main segments:



Critical Factors

A total of 61 critical factors were identified across the 5 segments of this production chain. These were analysed using 4 basic performance criteria - competitiveness, efficiency, quality and equity. The results fall naturally into three main clusters:

Factors related to accessibility: Availability of financial resources, availability of land, informal development, support for self-construction, regulation & coordination and the housing deficit. The critical factors related to housing accessibility are mainly linked to the criteria of equity. However some such as informal development and support for self-construction are associated to quality and sustainability. Actions to improve accessibility mainly belong to the politico-institutional environment of the production chain, for example in the field of housing policy, funding, regulation and the coordination of urban policies.

Factors related to Quality of Housing: Quality of housing materials, technical standards, organizational and institutional support for quality, knowledge of consumers' needs and conformance of components and materials to standards. Critical factors linked to quality mainly depend on the institutional and organisational environment of the production chain - technical standards, compliance, knowledge of consumer needs and the dissemination of quality programmes.

Technology and Management Factors: Project Management, barriers to technology adoption, productivity, loss and waste, construction costs and research. These critical factors are mainly linked to criteria for efficiency and competitiveness.

Prospects for the future

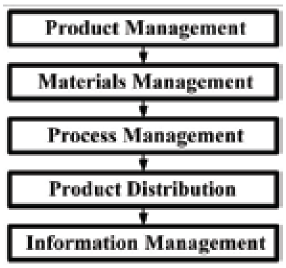
Techno-economic Prospects: An increase in the market for components and prefabricated products is anticipated however little progress can be seen for the moment. There is a need for cultural change. The uneven distribution of income makes progress difficult. Contractors make so little profit that they have no resources for training and capacity building.

Socio-political Prospects: The housing deficit and the growth of the informal construction sector have a strong influence on housing quality standards. Governmental regulation and new institutional support such as the creation of a National Certification System are needed to create more competitive, efficient, and equitable environment in the housing sector.

Sectoral Prospects: By 2013 the Brazilian housing sector will still be dominated by the use of traditional processes such as asphalt membranes (sistemas moldados in loco) and conventional materials. It is expected that the use of light prefabricated materials and metal structures will increase moderately.

Textile and Garment Manufacturing

The production chain for this sector is described as follows:



Critical Factors

Many internal, external and technological factors were identi-fied. These cluster into as follows:

Product Management: Research on fashion, new materials, new markets, and product development.

Materials Management: The acquisition of materials, selection and development of suppliers, and quality control.

Process Management: The qualification of human resources, plant acquisition and utilization, profits management, planning and control, prototyping, modeling and risk management.

Product Distribution: Sales.

Information Management: Information systems controlling productive processes and product development.

Future Prospects

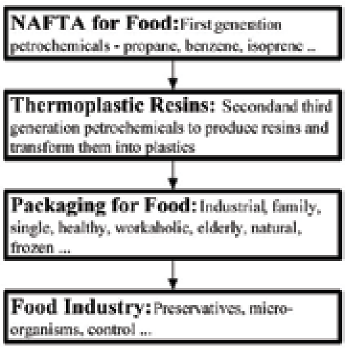
Techno-Economic Prospects: Increasing diversity of the global market will force suppliers to update traditional production skills. The promotion of free-trade areas will also reinforce competitiveness in the sector. Key future technologies include technologies compatible with CPTV, virtual clothing and 3D modelling systems, virtual reality, microelectronics, Microsystems, robotics, electro-optical components, Internet based integrated services, nanotechnology, fast prototyping, and marketing based on information technologies.

Socio-political Prospects: By 2013 there will be a polarisation of interests between countries dedicated to managing processes and those dedicated to executing processes (conception vs. implementation), an intensification of environment related trade barriers and further concentration of production in developing countries.

Sectoral Prospects: Increased internal demand will generate adaptations and new services customised to both individuals and cultural groups. Increased use of fibers based on PTT for differentiated, technologically sophisticated products as well as microfibers. Synthetic fibers will dominate the market.

The Transformation of Plastics

This exercise focused on production chains for plastic packing used in food. These were modeled as follows:



Critical Factors

An analysis of the sector discussed critical factors relating to competitiveness, productivity, infrastructure, employment, important dependency, export capacity, employment and the environment. These included access to raw materials, efficiency, quality and security, the availability of equipment, selling channels, size of enterprise, available capacity, potential capacity, business concentration, work-place supply as well as recycling and clean technologies. Future behavior of these critical factors was analyzed on the basis of an understanding of forces that would influence the future of food related plastic packing.

F01	Price of raw materials
F02	US Dollar parity
F03	International trade rules
F04	Scale of Production
F05	Production Chain Integration
F06	Company mergers and acquisitions
F07	Product substitution
F08	Product availability
F09	Adequacy of funding
F10	New consumer markets
F11	Type of packaging
F12	Fiscal incentives
F13	Diversity of consumer profile
F14	Number of producers
F15	Innovation
F16	Packaging in the food industry
F17	The tagging of packages
F18	The creation of clusters and cooperatives
F19	Informal sector
F20	Type of food
F21	Model separating centrals & refineries

The results are summarized in the following diagram:

Critical Factors	Enabling Forces	Hampering Forces
Access to raw materials	F02, F05, F06, F10, F11, F12, F14, F16, F18	F01, F03, F04, F09, F17, F19
Efficiency, quality and security	F08, F16, F18	F04, F17, F19
Equipment availability	F10, F11, F15, F18	F09
Selling channels and size of enterprise	F02, F04, F10, F11, F12, F15	F09
Available and potential capacity (import dependency)	F10	F02, F03, F18
Export capacity	F02, F10, F12, F15	F01, F03
Business concentration	F05, F06, F14	F19
Work-place supply	F14, F16	F12, F19
Recycling & clean technologies	F15	F19

Prospects for the Future

Techno-economic Prospects: By 2013 there will be more development and acquisition of technology oriented towards the substitution of imports. Substitution of NAFTA depends on the government's natural gas initiatives. There will be further concentration in the sector due to mergers and acquisitions. The main challenge is competitiveness.

Socio-political Prospects: The consensus is that the 'Zero Hunger' programme of the current government will have a positive impact on the sector. This could lead to support and strategic alliances that will reduce the effects of hampering forces in some segments.

Sectoral Prospects: Plastics will not be substituted by 2013. Plastic packaging for carbonated beverages and mineral water will dominate the market - where PET is the most used resin and blowing is the most applied process. Although there is a general agreement that supermarkets will maintain their role as main distributors, both private and public sector believe that small retailers will continue to play a role in the sector. Only the public sector has the optimistic view that NAFTA prices will remain the same in 2013.

Building Strategic Alliances

Foresight applied to production chains offers a fascinating framework for understanding the real complexity of long-term planning on issues concerning a large variety of interdependent stakeholders. The identification of critical factors for each segment of the production chain provides information that is extremely useful for those involved in policy development both from the industrial and public sectors. The development of visions shared by civil society as well as the public, private and academic sectors can result in the creation of unrealistic pictures or images of the future with little scope for coordinating joint actions and policies.

Foresight on production chains by no means guarantee that the outcomes of exercises will be easier to implement – this is a challenge faced in equal conditions by any activity aimed at the improvement or modification of the status quo. However it does help to establish a basis for building strategic alliances, strengthening institutional and organisational links and developing visions that take account of a broad set of stakeholder needs and aspirations.

Sources and References

The Brazilian Technology Foresight Programme Website: http://www.desenvolvimento.gov.br/sitio/sti/proAcao/proTecnologica/

The Brazilian Science and Technology Foresight Programme (Prospectar)

GOMES DE CASTRO, Antonio Maria, VALLE LIMA, Suzana Maria and PEDROSO NEVES CRISTO, Carlos Ma-noel. Production chain: A conceptual frame for supporting technological prospection. Espacios, 2002, vol.23, no.2, p.31-56. ISSN 07 98-1015

The BMW Region of Ireland 2025

Authors:	Kieran MOYLAN/ kmoylan@bmwassembly.ie Louise KINLEN/ lkinlen@bmwassembly.ie
Sponsors:	The Border, Midland and Western Regional Assembly with support from the 'Innovative Actions' Programme of the ERDF 2000-2006
Type:	Regional Foresight Exercise
Organizer:	Border Midland and Western Regional Assembly / www.bmwassembly.ie
Duration:	18 months | Budget: € 160 000 | Time Horizon: 20 years

Purpose

The purpose of the Regional Foresight exercise was to mobilise key players in the Border, Midland and Western Region of Ireland in order to develop investment priorities for the region based on long-term challenges and opportunities, expert input and inter-organisational collaboration that would position the region for development with a 20 year time horizon.

Background

The BMW Regional Assembly

The BMW Region of Ireland account for 47% of the land area of Ireland, 26.5% of the population and contributes some 19% of the GDP of the country. It is predominantly a rural region, traditionally dependent on the agro-food industry, tourism and manufacturing. It is currently in a state of transition, with a shift from more traditional sectors and more value-added manufacturing and services. The Region currently qualifies for Objective One EU funding, which is to be lost in the post 2006 period. The foresight exercise was a timely one, which helped players in the region to map out a desirable future and to pinpoint the investment priorities for the region going forward. The exercise was not limited to economic development and covered the themes of quality of life, competitiveness, knowledge, and innovation.

Determinants of Development

The following facts as identified by the BMW Regional Assembly and articulated during the initial panel meetings, set the context for the exercise:

- The 3rd EU Cohesion Report - defines new regional priorities, with a greater focus on the knowledge economy and an emphasis on assistance the Convergence regions, which does not include the BMW Region,
- The BMW Region will not qualify for Objective 1 type funding from the Structural Funds (ERDF & ESF) as it currently, nor transitional support,
- There will be greater emphasis in post 2006 EU funding on the themes of innovation, sustainability, human resources & less on hard infrastructure
- There is a need to identify regional priorities & feed these into post 2006 planning processes,
- Current changes & restructuring of BMW regional economy include a shift from more traditional manufacturing and agriculture to services and higher value added manufacturing,
- There is a need for greater emphasis on sustainability and longer term regional planning.

The objectives of the regional foresight were to:

- Prepare a commonly agreed development programme among policy making bodies,
- Involve all relevant stakeholders in the future development of the region,
- Enable a deeper understanding of roles, challenges, opportunities and benefits.

Furthermore it was important to build upon:

- The BMW Regional Audit of Innovation report,
- 14 County Development Strategies,
- Regional Planning Strategies,
- The National Spatial Strategy,
- The National Technology Foresight and the
- Strategies of the various Development Agencies.

The above documents and strategies set out regional and national priorities over long-term time frames ranging from 10 to 20 years. It was considered important that the Foresight exercise should build upon these and avoid contradicting or duplicating such previous work.

Methodology

Four Thematic Panels

The BMW Regional Foresight Exercise was designed around a series of four expert panels, addressing the following themes:

- The knowledge economy and up-skilling the labour force,
- The business environment and competitiveness, particularly, infrastructure,
- Innovation, research and information technology,
- Quality of life, spatial issues, social infrastructure, rural regeneration, tourism.

These themes were identified for their broad-based nature and are consistent with the priority issues identified in the Lisbon Agenda and in the European Commission's recent reports on the future of structural and cohesion funds.

The BMW Foresight process was overseen by a Steering Group comprising key institutions operating in the region. The Steering Group's role was to guide the foresight process and consider findings on a regular basis. Each thematic panel met on four occasions at different locations within the BMW region (Tullamore, Carrick on Shannon, Athlone, and Mullingar). These meetings produced stimulating discussion and debate. The early work of the panels focused on identifying local and global trends (panels 1), considering strategic challenges and developing scenarios for the future of the region (panels 2).

The purpose of the scenarios was to stimulate discussion on a desirable future for the BMW Region under each thematic heading, and assist in planning the strategic responses necessary to address the challenges and realise a more favourable scenario for the region. Challenges identified included issues such as the declining rural economy, out-sourcing of labour to cheaper economic zones, environmental pressures, increasing need for childcare and lack of regional policy-making structures.

In order to 'test' the emerging scenarios with a wider audience, a series of regional and national consultations were carried out. These aimed to gather views, ideas and preferences to inform the shape and content of the BMW Regional strategy. Workshops were undertaken with a range of business and policy organizations, and were supplemented by invitations to submit electronic feedback through the BMW Regional Assembly website .

Each consultation sought views on the following questions:

- Is this a desirable future for BMW region?
- How would you summarize the policy developments implicit in this scenario that will allow it to become a reality?
- Which of these policy developments needs to be given priority?
- What factors may prevent the scenario from being realized?

The second half of the Regional Foresight process asked the panels to consider the feedback from the consultation, agree the key priority themes for each panel area, and specify in each case the policies that would enable these to be achieved (panel meeting 3). The panels were then asked to agree a final report and recommendations (panel meeting 4).

Further discussions were also held with national level organisations. The final output from this process is a strategy document containing strategic visions for the region, as well as investment priorities, measures and priority projects.

What type of future for the BMW Region? Identified Policy Drivers

A number of factors were identified that will drive change in the BMW Region over the next 20 years. These consisted of both global trends and key EU, national and regional policies and strategies. The global trends identified were:

- Effects of globalisation,
- Demographic change,
- Increasing pace of innovation and technological change,
- Changes in attitudes to work, relationships and organizations,
- Transition to a knowledge economy,
- Increasing value given by society by the quality of life and living,
- Rural pressures and policy changes,
- Changes in governance patterns.

A Vision for the BMW Region

Moving Towards Sustainable Prosperity and Competitiveness

The following vision emerged from the process:

The BMW Regional Assembly will become an innovative, knowledge-based and competitive region, with a high quality environment, first class infrastructure, visionary leadership and a quality of life for its citizens that is among the highest in the world.

The Thematic panels also identified five components as essential means by which the above vision can be achieved.

The five components provide a focus for the BMW Region to construct a new, desirable future while anticipating, responding to and embracing the challenges facing the

Region in an increasingly globalised and changing economy and society:
- A region where entrepreneurship, learning and knowledge are the cornerstones of prosperity
- A region with internationally competitive businesses and a business environment conducive to investment
- A region where infrastructure networks provide access to 21st century resources
- A region where sustainable communities enjoy a high quality environment
- A region with visionary leaders and effective regional management.

During the Foresight process, the following cross-cutting themes emerged as being central to all elements of the strategy and are thus included here as horizontal principles, to be integrated into the implementation of all measures:
- Sustainability,
- Equality of opportunity

Priority Initiatives for the Next Five Years

Following on from this, 10 specific objectives and relating actions were identified, to be complimented by a number of priority initiatives, to be implemented within a short timeframe (five years):
- Scoping of long-term challenges and opportunities
- Agreement on regional investment priorities
- A strategic vision for the region was articulated
- Shared ownership of process and outputs
- The foresight exercise stimulated collaborative and innovative thinking among the key stakeholders
- Engendered leadership and a stronger regional identity.

Stopping Regional Divergence

New measures are required for effective regional policy in Ireland in order to ensure more balanced regional development and to slow down the trend of regional divergence. Regional policy making is currently very weak due to the lack of regional structures and systems.

There is need for sustained and **broadly-based investment** programmes over the 20 year time frame in order to maximise the region's contribution to economic growth and competitiveness. These include **investment in areas such as infrastructure, telecommunications, childcare and linkages between third level institutions and industry.**

Further, there is need for a **co-ordinated approach** to the delivery of investment and the monitoring of impacts at local regional and national levels. Currently there are many different organisations at national, regional and county levels involved in the delivery and administration of programmes.

Higher education institutions in the region play a crucial role for the potential of growth. There is only one university in the BMW Region, compared with six in the other region of Ireland. There are however a number of institutes of technology, whose research capacity and interaction within enterprise and the community could be strengthened.

Long-term Objectives on all Levels

The ten critical areas for action identified in the process expressed as strategic objectives to be achieved are:
- Knowledge Objective: Place third level institutions at the heart of the region's future prosperity. These include the university and the institutes of technology as well as a number of other higher education colleges.
- Innovation Objective: Create innovation and entrepreneurial culture throughout education, institutions, business and communities.
- Clustering Objective: Improve the critical mass and impact of investment by building on existing clusters of activity (e.g. medical devices) and concentrating investment effectively.
- Spatial Investment Objective: Invest in infrastructure that builds on the National Spatial Strategy (a national spatial planning document 2002-2022, which identified growth centres and strategic linkages between them).
- Leadership Objective: Strengthen regional leadership and implementation of investment (the Irish administrative system is currently highly centralised and regional structures and policy-making capacity are very weak. Strengthening regional leadership would entail strengthening regional structures, the building of a stronger regional identity and encouraging the emergence of regional leaders at the level of organisations and individuals).
- Skills Objective: Invest in attracting and retaining skills. There is currently a shortage of graduates in the region, with many of the region's graduates leaving the region to seek employment elsewhere. Various schemes could be put in place to encourage the recognition and employment of people with specific skills (e.g. research, marketing, languages, IT, biotechnology) and create incentives for highly qualified people to seek employment in the region.
- Business Support Objective: Invest in leading edge business support.
- Environmental Objective: Invest to make the region's high quality environment sustainable.
- Community Objective: Invest in the region's communities and social capital in order to ensure their sustainability.
- Social and Knowledge Infrastructure Objective: Invest in the physical infrastructure that will maximise the social and knowledge capital of the BMW Region.

Lobbying for Implementation

The Foresight report has just been published and is due to be launched in September 2005 by a senior Government Minister. The report is currently being presented to a number of key Government departments at agencies and members of organisations who participated in the various panels and steering committee have agreed to lobby for its implementation within their own institutions. As a part of the process, a system of implementation and monitoring was put in place, with agreed periodic reviews and monitoring, using various indicators by the Steering Committee.

It is also being used to feed into the process of post 2006 planning and will most likely form an essential component in the identification of investment priorities for the Regional Operational Programme (ERDF co-financed) for 2007-2013. A number of meetings are commencing to identify investment priorities for future EU and national funding programmes and the Foresight report is being used as one of the baseline documents for the BMW Region.

Sources and References

Further information on the BMW Regional Foresight exercise is available on the Border, Midland and Western Regional Assembly's web-site **www.bmwassembly.ie**

Bionic Buildings 2020 – Applying Natures Principles for Intelligent Building

Authors:	Susanne Giesecke, ARC systems research GmbH, Vienna/ Susanne.Giesecke@arcs.ac.at Sabine Hafner-Zimmermann, Steinbeis-Europa-Zentrum, Stuttgart/ Hafner@steinbeis-europa.de		
Sponsors:	German Federal Ministry of Education and Research (BMBF)		
Type:	Issue as part of a national foresight exercise (Futur – the German Research Dialogue)		
Organizer:	IFOK GmbH, Fraunhofer Institute for Systems and Innovation Research (ISI), Institute for Futures Studies and Technology Assessment (IZT), VDI/VDE Innovation + Technik GmbH, Pixelpark AG		
Duration:	2003-2004	Budget: Not available	Time Horizon: 2020

Purpose

This issue brief reflects one of three topics that the German research dialogue 'Futur' dealt with during its second phase from 2003 to 2005. The topic 'Bionic Building' was selected by the Ministry of Education and Research following a participatory process of topic generation. It aimed to define future research needs and possible research priorities to guide the German Federal Ministry of Education and Research in its future funding decisions. The process which comprised several workshops involved about twenty participants from architecture, urban planning, science, technology and research, both from the public and the private sphere. It resulted in the formulation of a thematic paper on the topic and a scenario where a possible future of bionic housing is vividly described.

Why Bionics?

Applying nature's principles for building and housing is a new notion for future research and development applying the concept of bionics to building and housing. Other than fixed architectural structures it includes the flexible and adaptive use of buildings or components that are able to be changed according to the changing demands of its inhabitants, thereby increasing the well-being of its inhabitants and minimizing the use of resources.

- Principles of bionic building are increased quality of living, sustainability, and marketability in the field of building and housing. The areas of research are urban planning, construction, technology development with respect to bionic housing and living, utilisation of individual buildings, clusters of buildings, urban structures, and infrastructure.
- The resulting products and processes are supposed to meet the criteria of adaptability, user friendliness, auto-regulation, appropriateness, reliability, and aesthetics.

The principle of bionics relates to structures and processes imitating nature's mode of organisation, optimization and adaptation, e.g. commonly known is the 'Lotus effect'. This does not only mean to imitate singular solutions but rather the application of holistic systems. Bionics implies using the most efficient solution while employing a minimum of resources.

A Participatory Process

In general, the Futur process was supposed to complement the traditional agenda-setting in the Ministry of Education and Research with a participatory component. Up till quite recently, the decisions on new funding areas and research programmes were taken by way of a rather closed interaction between industry, research organisations, project managing agencies and ministry officials. Thus, Futur was set up to add an open discourse of non-traditional stakeholders such as NGOs, small and medium-sized enterprises, scientists and others.

By using such a participatory approach, the Futur process sought to include the dimensions of future orientation and 'societal needs' into the conventional decision-making process of the ministry. This was expected to strengthen the demand-side of research priority-setting in contrast to the supply-side approach which had been used before exclusively. The Ministry expected to attain more future-oriented and innovative research agendas by this approach.

The Futur process was characterised by the following principles:

- Involvement of a broad variety of different stakeholders to ensure **interdisciplinarity.**
- High **transparency** of the process to ensure continuity, stability and traceability.
- **Reflexive learning** was an important aspect enabling to adapt the process if necessary.
- The process needed to include **demand-orientation** to guarantee that future needs of society are taken into account adequately.
- The process was supposed to be **open to results** meaning that it acted independently of current research areas or programmes in the Ministry.
- Finally, the process was supposed to promote **awareness-raising** in society and its results thus needed to be formulated in a way **understood by everybody.**

The Futur process was organised along several thematic workshops. Each topic was elaborated in four workshops by so-called 'Focus Groups' and resulted in a comprehensive theme paper and a scenario. The first workshop on the 'Bionic Building' topic was a so-called future workshop which was used to develop visions about the topic and possible ways for realising them by way of a creative and interactive process. Following, three Focus Group meetings were conducted. In the first two workshops, the topic was narrowed down and its aspects were discussed and defined within the working group. The last meeting was conducted as a scenario workshop to create input for a publishable scenario which was written on the topic. After the Focus Group work the Futur consortium finalised the theme paper and the scenario in autumn 2004.

The around 20 participants of the Focus Group came from various professional and thematic backgrounds. Among them were representatives from large as well as small and medium-sized companies, from science, universities and private institutes, dealing with construction, building, infrastructure, environmental, technical and design aspects of bionics and conventional building and housing.

Overcoming the Limits of Conventional Building

Traditionally, housing, urban structures and respective infrastructures are built for long-time usage. Thus, the resulting structures are fixed and incompatible with changing living situations of its inhabitants who have to cope with changing living conditions, needs and requirements in a dynamic environment which is getting more and more complex and unpredictable. Facing the accelerating demographic change and the ageing of German society, future buildings will need to incorporate very different features than they perform today, meaning they might need to be dismantled and re-naturalized, or that they are subject to conversion or even deconstruction.

The concept of bionic building is not only to be applied to new buildings but also to the remodelling and conversion of existing buildings, urban structures and infrastructures. But creating entire urban structures following bionic principles seems to be a future vision. Challenges of today and tomorrow are the modernization of present buildings. This objective has be seen as a successive and invasive process, possibly integrating approaches using bionic principles from various starting points, slowly transforming housing concepts, urban structures and infrastructures – utilities as well as institutional infrastructures such as hospitals, kindergartens, work places etc.

Economic Aspects of the Construction Industry

The construction sector makes up 4% of German GDP and accounts for 6% of employees. Together with the related industries and services along the whole value chain the construction sector is one of the most important sectors of the German economy - and it is one most depending on the business cycle. Since the construction sector is structured very traditionally and subject to a high degree of liability it does not react flexibly to changes and challenges. Besides, another problem German construction industry is facing are increasing costs. It would therefore be a challenge to create equally good construction solutions while decreasing costs. It thus seems to be about time for some fundamental modernization – especially given the fact that the globalization of the construction sector poses a severe threat to the German economy.

Ecologic Dimensions of the Construction Industry

The traditional construction industry has a huge demand for resources. In Germany it accounts for nearly one third of the energy and material consumption and one third of the emissions. Other ecological problems are posed by the rising quantity of waste which accounts for some 40% of all waste in the country, not to mention the high demand of water, interference with the natural ecosystem and the consumption of space.

Thus, it is high time to apply an innovative approach to construction, building and housing such as bionics to counter the adverse effects mentioned.

New Areas for Research

Bionic building is a striking new idea of creating and remodelling individual houses, clusters of houses, urban structures and infrastructures. It is therefore no surprise that this theme finds no academic equivalent, even though aspects touched by the concept of bionic building are researched in some established disciplines and funded in conventional research programmes, e.g. such as new energy technologies and materials. The holistic and systemic aspects of bionic building has, however, not been dealt with comprehensively yet. However, this field would offer the opportunity of a generic multi-disciplinary approach to science, research and development.

The holistic approach

In order to apply bionic principles for future housing this new and innovative approach has to integrate three subsequent processes:

- Planning: definition of objectives by applying bionic principles which can be realized during the construction, operation and possibly the recycling phase; anticipation of alternative/multiple options for usage,
- Construction: realization of the objectives by applying bionic principles, or optimization of existing structures through bionic principles,
- Operation: solutions should be adaptable along with changing objectives and demands.

Combining Societal Needs with Principles of Nature

The three phases of constituting the holistic approach described above have to be designed according to criteria that grant maximum quality of life to the inhabitants of the building/urban structure while acknowledging the principles of natural efficiency and optimization. During the process of Focus Group meetings, six criteria were identified by the Focus Group participants:

- **Adaptability:** includes the possibility to adapt houses/urban areas to the changing living situations of its inhabitants (e.g. number of inhabitants, age, income) as well as to the changing conditions of the environment (e.g. day/night, seasons); this implies also the development of adequate information technologies and new materials.
- **User friendliness:** all applications should be easy to use by all inhabitants without any lengthy learning processes, but by intuition; furthermore, the application should be low in maintenance, easy to clean and offer options for dismantling and/or denaturalization.
- **Autoregulation:** implies the automatic regulation according to benchmarks set by the users of the house/urban structure that offer most comfort and a healthy climate; this might imply new IT applications and concepts of ‘self-diagnosis’ and ‘self-healing’.
- **Appropriateness:** all functions of the house/urban structure should be applicable with the least possible effort and resources according to the principle: the simpler the better; changes that have to be made in order to adapt to alterations of life style or the environment should be realized by modular solution, e.g. enlargement, diminution.
- **Reliability:** all functions should be constructed in such a way that their reliability is guaranteed even in case of stress, e.g. natural disasters; this implies that some utilities have to be built in a very robust manner and/or in a redundant way, independent of overburdened networks that can be subject to severe external disruptions.
- **Aesthetics:** design that imitates or adapts natural and organic forms is usually considered pretty; therefore, this kind of design should be combined with optimized functionality according to bionic principles (form follows function).

Options for Future Innovation

When measuring existing buildings against the principles of bionic building it becomes clear that a multitude of alterations would be necessary. Accordingly, the discussions of the Focus Groups resulted in the identification of the following options for future research related to bionic building:

Optimizing the Utility Infrastructure

Innovation is needed with regard to increasing comfort and efficiency while using less energy and fewer resources. One challenge is the life cycle of existing conventional utility infrastructure which usually lasts several decades and is seldom renewed. It has thus to be assessed if future buildings can include semi-independent utility systems in order not to connect too much to the traditional ones if they are not appropriate. Related to this is the development of local and regional resource cycles.

Light and Energy

The objective for further research is how to better make use of sunlight as a source of light and energy and how to adapt to natural cycles of lightness and darkness, thereby increasing the well-being of the inhabitants. This implies also the efficient usage of other renewable resources such as biomass, water, wind and geothermal energy for local and regional energy cycles.

Urban Structures

Social and functional structures are to be designed in such a way as to minimize the effort, time and energy to organize one’s social life, e.g. short distances between home, work, school, business districts, including the adaptability and flexibility of transport systems to the needs of the inhabitants.

Multi-functionality

The principle of multi-functionality applies to the changing needs of inhabitants of buildings, e.g. the changing size of families, the differences between young people with or without children and elderly people, and the possibility to house all these types of households in one building or one local urban area and to maintain a multi-cultural society. One additional feature in this context is the adaptability to the changing acoustic environment. Different living situations or the increase of traffic may result in the demand to decrease noise either by applying dampening material or by constructing intelligent noise-absorbing buildings/ components.

Modularisation

Modularisation deals with the relation of size and functionality. Of what size can bionically constructed entities be in order to operate efficiently? How can they be altered once they have been integrated into a building to adjust to changing demand? How can different modules be combined in new constructions and in existing ones? Can specific appliances be pre-constructed or even mass produced? Is customized mass-production in combination with bionic principles an option for the sluggish German construction industry?

On the Verge of Implementation

The theme of bionic building has been accepted as candidate for a future 'lead vision' as a result of several voting processes by Futur participants and policy actors. Once the lead vision is passed by the Minister for Education and Research the theme is to become a priority for future funding programmes combining several disciplines of research. After the elaboration of the topic has been concluded by the Focus Group and the Futur consortium, the theme paper and the scenario have been passed on to the Ministry in autumn 2004. Following, the Ministry of Education and Research analysed all three theme papers which have been elaborated during this Futur phase, Bionic Building being one of them. Out of these three topics, the best one(s) will be chosen to officially become Futur 'lead visions'. These topics will then be used by the Ministry to design and issue interdisciplinary research projects and programmes.

But up till now, no decision on the lead visions has been taken by the Ministry and as there will be national elections in Germany in September 2005, it is unclear if this will take place at all before these. Thus, no official implementation activities on the topic have taken place yet. The latest news on the topics pending and on their implementation can be found on the Futur website.

But in general, the interest in the subject of bionics and beyond has increased. In May 2005 the Ministry has issued a call on the innovative potentials of bionics to assess future options for research policy, funding programmes and economic prospects.

Sources and References

- www.futur.de
- Bundesministerium für Bildung und Forschung: Heute schon das morgen denken. Bonn, Berlin 2004
- As of August 2005, there is no official BMBF-publication on this Futur-topic yet.
- Terminology and translation of key words are the official wording of the German Federal Ministry of Education and Research.

Dynamo 2004

Authors:	Maurits Butter/ maurits.butter@tno.nl
Sponsors:	The Dutch Ministry of Economic Affairs (Jan Pieter Mook)
Type:	National foresight exercise
Organizer:	TNO, Maurits Butter - maurits.butter@tno.nl NWO - The Dutch Organization for Scientific research, Wilma Donselaar - donselaar@nwo.nl SenterNovem - The Dutch governmental agency for sustainability and innovation, Marcel Kleijn - M.Kleijn@senternovem.nl
Duration:	2003-2004 Budget: € 250 000 Time Horizon: 2010-2015

Purpose

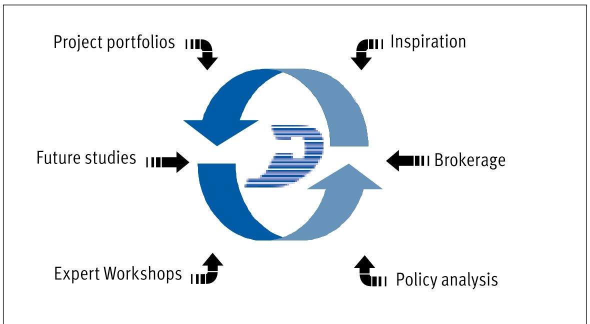
The Dynamic monitoring project of the Dutch Ministry of Economic Affairs was a pilot project to gain experience with dynamic and monitoring of future development for business inspiration and policy orientation. It was part of a systematic approach to identify and focus strategic research areas for innovation in the Netherlands for the next decade and link it to the programmatic funding of R&D.

Towards Dynamic and Systematic – Monitoring of Future Innovation

In the late 1990s, the Dutch Ministry of Economic Affairs launched a broad foresight exercise to identify major research and innovation areas important to the Dutch economy. After the experience of the Technology RADAR and other international foresight programs, the Dutch Ministry of Economic Affairs came to the conclusion that the effects of a large Foresight Program were limited, and much information was already (internationally) available. On the other hand, there was a need to anticipate on future developments, both from an industrial and governmental perspective.

Looking for opportunities

To address this problem, early 2003 the Dynamo approach was developed as part of a foresight process in order to gain a better view of the relevant national and international innovative developments at a mezzo- or thematic-level.



The overall aim of Dynamo was to facilitate economic development by offering concrete information about possible present and future innovations and issues.

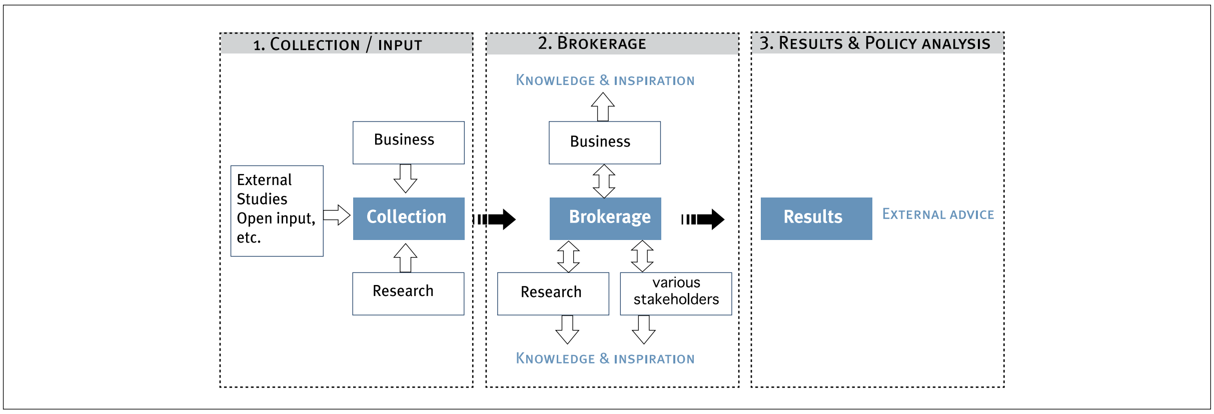
So, Dynamo puts content in the heart of the process. This overall objective is divided into the following objectives:

- To offer information to inspire industrial and research stakeholders into new economic activities.
- To identify and broker possible new areas of co-operation in business and research.
- Offering a platform for dissemination and networking using existing information.
- Feeding the policy process with future oriented knowledge.

Connecting Systematic Monitoring, Inspiration and Policy Development – The Three Stages

The basis of the approach is formed by a continuous gathering of information about important future developments that could be of interest to the Dutch economy. It collects data on the micro level and draws conclusions to the meso level. The information on future developments was gathered by screening future studies and the national research portfolios of SenterNovem, NWO (national funding agencies), and TNO on possible innovations.

The innovations were clustered to innovation themes, on which brokerage meetings were organized. The objectives of these brokerage events were to discuss the value of the themes to the Dutch economy and to initiate networks between research, industry and government.



The third stage focused on the policy analysis and policy development. Using an expert panel from industry and research, the findings of the process were analysed and themes prioritized.

A relational database was developed as a central to facilitate systematic gathering of information and enable flexible input and output, and statistical data analysis (The Dynamo expert system).

From 600 innovations to 35 innovation themes

During the exercise, a clustering to themes took place. Dynamo started with 650 innovations, gather from a previous round (200), SenterNovem portfolio (200), NOW portfolio (150), additional foresights (50) and TNO portfolio (50).

All innovations were profiled according to relevant industrial sectors and research areas, using the NACE code and Frascati. This enabled a clustering of related themes, based on similarity index. After a process of computer facilitated clustering and expert panels, 35 main innovation themes were identified.

The objective of brokerage and identification of themes were tested during the 'Dynamo Theme Day'. Some 65 participants were present and represented industrial firms, RTOs, government, branch organisations and intermediary organisations. During the day, the Dynamo database was presented and five themes discussed. During the final sessions the added value of the Dynamo database and the underlying process was discussed.

The themes to be discussed were identified by the selection of participants whereby the following five were considered to be of high importance:

- Sensor technologies,
- Medical diagnostics,
- Enabling technologies for life science,
- Transport safety and efficient automobiles,
- ICT services.

The results of the Dynamo theme day were positive. It showed that new inspiring themes and topics were identified in the collection stage and industry and research appreciated the approach. However, the themes identified for governmental priority were not accepted as priorities for the expert panel due to a low level of stakeholder commitment.

Overview of identified themes	
Devices for computing and communication	Environmental technologies and management
Coating and other surface technology	Medical drugs and therapies
Enabling technologies for life sciences	Logistics management
Infrastructural works	Chemical conversion technology
Mining of natural resources	Industrial biological technology (white biotech)
Indoor climate systems	Transport safety and efficient automobiles
Materials and construction testing	Sensor technology
Software for computing and communication	Industrial energy systems
Ship building and water transport	Food production technology
Food preservation, quality and safety	Building methods and concepts
Building materials	Industrial safety
Industrial manufacture technology	Agricultural production and management
Public energy systems	Packaging technology
Medical implants and transplantation technologies	Tools and methods for designing products and constructions
Micro- and nanoscale applications	ICT networks and infrastructures
ICT services	Medical diagnostics
Industrial separation technology	Metals and metal products
Plastics and Polymers	

Conclusion: High Industrial and Low Political Usability

Recognized themes and innovations

In some panel sessions, the identified themes proved to be highly relevant, but the added value to more general insight was limited. On the other hand it was not expected that the process would identify totally new themes, because the information source was "existing information".

The approach to create inspiring new demand oriented themes based on the information gathered proved to be a complex process, with fundamental issues (e.g. how to systematically cluster innovations). The inspiring character of the identified theme names was limited and the theme names needed to incorporate the innovative element in the research area.

Also the innovations gathered were mostly 'known'. However, most experts participating in the Dynamo theme day concluded that although most were known, the unknown were of high importance and had high added value.

The identification of innovations looking at the research portfolio of NWO was hard. The researchers found it difficult to translate new scientific insights to possible commercial innovations.

Need for systematic gathering of information

The Dynamo 2004 project showed the need for content oriented information. Although the last decade the shift from forecasting to foresight was made, emphasizing the need for participatory activities, industry, research and government showed a positive attitude for more content oriented projects. But much data is present and just must be systematically collected. The clustering element into innovation themes proved to be of crucial importance.

The shift from research to innovation was another crucial element to make the information more demand oriented (instead of supply). This approach links research and industry.

The government should organize the systematic collection of data. Both industry and research proved to have a need for this type of information, but are unable to develop a systematic approach. An international approach would be welcome.

Industrial and research need for brokerage

Presenting information is not enough. The Dynamo approach included an internet accessible data system, which was considered added value, but the organization of focused workshops on specific innovation themes was highly welcomed. They proved to be inspiring events, but also had to be placed in a more long-term strategy to keep the initiated momentum.

Dynamo added-value to industry

The Dynamo expert system had high added value. The systematic, but dynamic access to the information facilitated different types of users to get new inspiring information for their own perspective.

There was high demand for a brokerage functionality of Dynamo, facilitating creating contacts between possible users of innovation and suppliers. However, this functionality had some fundamental problems in declassifying the information.

The Dynamo interface proved to have an expert character, in stead of a layman character. For broad use of the system, the interface has to be more user-friendly.

Political aspects of identification of policy priorities

The Dynamo 2004 project was a pilot project. The added value to the industry and research was considered high. But from the governmental point of view some fundamental drawbacks were identified. As it showed, the process of selection of governmental priorities is highly political and the objective to identify innovation priorities needs a different process with high stakeholder involvement. The Dynamo expert system can facilitate this process, but will be of limited value.

Spin-off and Follow-up

RADAR 2004

The Dynamo 2004 project initiated a project for the installation branch, initiation new innovations. The approach used had three steps:

- Systematic gathering of future developments
- Identifying important innovation themes
- Selection and making them operational

This project has a high success in initiating innovation in the sector.

New innovation policy process

Within the government, a direct follow up of Dynamo was cancelled. As one of the objectives to identify innovation priorities proved to be a more political process, a systematic system to gather future developments was considered of little added value.

However, the value of Dynamo expert system for stimulating innovation in industrial sectors was considered of value. Therefore, the ministry was supportive to a trajectory to further develop the Dynamo expert system as a network/ brokerage system for the industry.

Mid 2005 the ministry will rethink its role in foresight for the Dutch economy. Important aspects are how to collect information, how to cluster information and how to set up focal workshops with initial stakeholders.

Dynamo and TNO

The Dynamo expert system has become a major asset of TNO, now used in over 10 projects. Discussions with several sectoral organizations are initiated to further develop the expert system, as well as the Dynamo approach to stimulate innovation.

Sources and References

The TNO Dynamo website: www.dynamo.tno.nl

Transport and Mobility in an Enlarged Europe – 2020

Authors:	Liana Giorgi/ l.giorgi@iccr-international.org		
Sponsors:	EC Fifth Framework Programme for RTD 1998 to 2002 - Sustainable and Competitive Growth General Directorate for Energy and Transport		
Type:	European sectoral foresight focusing on transport and mobility		
Organizer:	The ICCR - Interdisciplinary Centre for Comparative Research in the Social Sciences The contact person is Liana Giorgi /l.giorgi@iccr-international.org		
Duration:	2002-2004	Budget: € 1 049 000	Time Horizon: 2020+

Summary

This brief reports on the experiences made in the 'Foresight for Transport' project. The project was undertaken to test the applicability of the foresight method for visioning transport and mobility futures and specifying impact pathways. Special attention was placed on the impact of external developments on transport and mobility. The implementation of the study entailed the organization of thematic expert panel consultations on the topics of enlargement, environment and energy, multilevel governance, information and communication technologies and time dynamics, a Delphi survey involving 165 experts around Europe as well as the establishment of a meta-database system with information on indicators that can be used to monitor developments in fields of relevance for transport and mobility.

A Holistic Approach for Assessing the Future of Transport

The decision to run a foresight exercise on European transport policy was motivated by the recognition of the limitations of mainstream policy assessment methods and, more specifically, transport models, with regard to the identification and analysis of the impact of non-transport or 'external' factors on transport and mobility.

An alternative approach is to focus on unveiling how changes within the external or policy environments come to impact on transport and mobility. The key term here is 'how', hence also the organization of the research around the notion of 'impact pathway'. In other words, while models work with already established assumptions about cause and effect in order to achieve estimation and valuation of impacts, the study has sought to clarify the cause-effect relationships as processes – in time and through a range of intermediate variables or policy domains. Understanding process in conceptual terms, i.e. the impact pathways, implies integrating specialized knowledge as well as different normative appreciations regarding the future.

Moving Beyond 'Strategic Modelling'

The 'Foresight for Transport' study had as main objective to clarify the pathways through which external and/or policy variables impact on transport and mobility. The following figure represents the conceptual framework of the study.

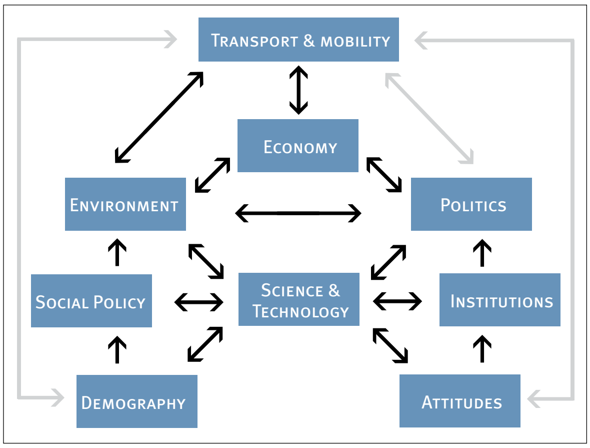


Figure 1.
External features influencing mobility and transport and possible links

The underlying assumptions are as follows:

- First, the more distant external elements are to be found from the top box representing mobility and transport, the weaker their direct impact will be. An example of this is the way in which demography impacts on mobility.

- Second, science and technology is centrally and vertically located in the above diagram to represent how this is influenced but also influences other external factors and, hence, mobility and transport. Innovations are alone not enough to effect a significant change of policy. The diffusion of innovations is equally, if not more, important.
- Third, the location of the triangle politics-environment-economy close to the top is indicative of the significant role of business and industry, on the one hand, as well as politics, on the other, in filtering developments from other 'lower-level' factors and in having an own sustainable impact on transport and mobility. The addition of environment to this core reflects the broad consensus that the environment is a key factor for determining the societal sustainability of the future.
- Finally, continuous lines or arrows indicate stronger impact pathways than broken lines or arrows. The positioning of the external dimensions as well as the strength of the relations between them can change depending on what future is envisioned. The constellation presented in Figure 1 is a generic one that corresponds closest to the 'business-as-usual' scenario.

Combining Qualitative and Quantitative Instruments

The time frame for this Foresight exercise was the time from now until after 2020, distinguishing between short-term (2004-2009) medium-term (2010-2019) and long-term (2020+) perspectives. Geographically the exercise focused on the enlarged European Union.

The elaboration of impact pathways that link external elements to mobility and the transport system was done in four steps: First an expert knowledge base on each of the external dimensions was compiled. This involved understanding what drives developments for each, what are the main contextual issues involved and how these are likely to play out in the future. Second, measurable indicators were defined for each dimension and available data was collected in an attempt to describe actual trends and estimate how these might develop in the future. This established a basis for the reference scenario that describes the present and the latter's trajectory into the future. Third, alternative ways in which the various dimensions correlate with each other and with transport and mobility were envisioned. Such alternative global futures provide the setting for specific impact pathways. The fourth step was that of specifying the impact pathways at the micro-level as well as the degree of association between factors that are linked along this pathway.

This Foresight exercise used a variety of techniques and combined both qualitative and quantitative methods:

- **Expert Consultations:** The 'Foresight for Transport' project organized two rounds of expert consultations. The first round (60 experts) took place during the project's first year, lasted a full week and was used to gather knowledge relating to external dimensions. The second round was a smaller consultation exercise (12 experts) and took place towards the end of the project. Its objective was to refine the transport impact pathways.

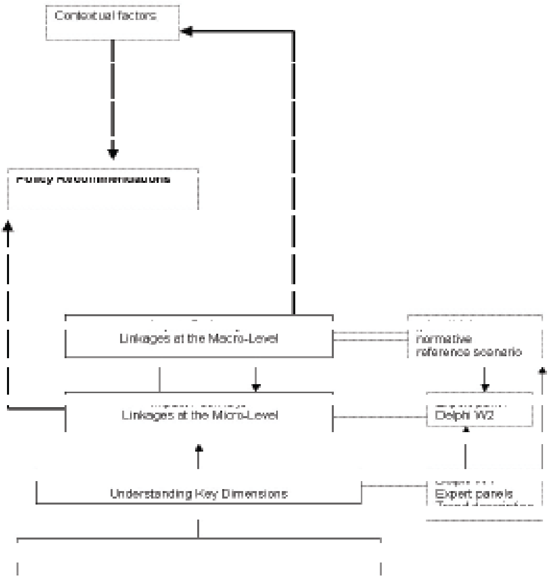
- **Brainstorming:** The expert consultations used the brainstorming and scenario-writing techniques to guide the deliberations. Following the exchange of ideas on important drivers and issues, participants were asked to think in terms of their temporality, their geographical scope and their relevance for transport. This generated the classification of drivers and issues in the eight-fold scheme of Figure 1.

- **Scenario-Writing:** Participants were provided with a summary of the issues produced through brainstorming in their respective sessions and asked to select those that would be most suitable for describing (a) the present situation and (b) possible futures. Through deliberation each group came eventually to agree on the baseline scenario and a limited set of alternative futures. The core research team of the 'Foresight for Transport' project used these to specify a generic baseline scenario and seven alternative future scenarios.

- **Delphi Survey:** The 'Foresight for Transport' project used a two-wave Delphi survey over a period of nine months in 2003. The first-wave questionnaire was distributed among 455 experts and sought to validate the results of the first round of the expert consultations on critical non-transport factors and scenarios. The second wave questionnaire fed back to respondents the results of the first wave of the survey and asked them to reflect upon or confirm their original choices. Against this background, several transport impact pathways were submitted for commenting and validation.

- **Trend Extrapolations of Key Indicators:** In 'Foresight for Transport' trend extrapolation was used for indicators selected as important for monitoring future developments with regard to either transport or external developments.

- **Process Management:** The following figure displays the process management of the 'Foresight for Transport' study towards the arrival at substantive outputs.



Identifying Impact Pathways

Eighteen transport impact pathways were elaborated by the project and validated through the project's Delphi survey and second round of expert consultations. These impact pathways deal with the following subjects:

Regarding individual mobility and passenger transport:

- The way **ageing** will affect transport demand as well as leisure patterns and the number of trips.
- The way in which the **respect for time**, speed and flexibility influences motorization and travel patterns.
- The impact of **attitudes to the environment** on the use of the transport system.
- The effect of a more **flexible of the labour market** on the type, length and frequency of local trips.
- The effects of the **decentralization** of transport policy competences, including how conflicts on land use may affect network development.

Regarding (primarily) freight transport:

- The impact of the emergence of a **European level** of decision-making with rising competences on network development and infrastructure investment.
- The role of **technological innovation** and diffusion on transport demand and on the environment (through transport).
- The way in which **economic growth** in the context of enlargement can be expected to influence trade patterns and transport demand.
- The impact of restrictive **migration policies** on transport efficiency.

In the elaboration of the transport impact pathways particular attention was placed on specifying not only what drives developments but also what mediates development. External factors have often a much bigger role to play in this respect.

Implementing Sustainable Mobility

Individual mobility and, hence, short-distance passenger transport is especially receptive to external influences deriving from non-transport policy domains and relating to work, lifestyle, settlement and demographics. It is in these more 'distant' (see Figure 1) policy domains that we must look for drivers and mediators of change. The 'distance' of these policy domains from the core (of transport and mobility) also suggests that the changes thus effected are gradual and slow. It follows that, in order to be successful, mobility management within transport policy must elaborate strategies that are in line with contemporary forms of living and working and take into account demographic developments and settlement patterns. In addition, modern mobility management should try to effect changes within the above external policy domains that are consistent with sustainable mobility, for instance through the promotion of housing or labour market initiatives that take into account transport and environmental constraints.

Freight Transport Policies on Broad Geographical Scale

Freight transport is a field which is more 'closed' in the sense of having clearer and more restricted boundaries of influence. The core triangle of economy, environment and technology (Figure 1) is what drives developments. Change can be effected within this extended transport policy domain. A policy mix comprising investment, pricing (including environmental taxation) and technological measures (with regard to new sources and more sustainable uses of energy as well as the deployment of communication technologies for advanced traffic management systems) is largely adequate for effecting change towards sustainable mobility. The main challenge is, however, how to implement such policy mixes at a broad geographical scale. In this regard, the success of the European Transport Policy will ultimately depend on the ability of the EU institutional framework to perform well as a multilevel governance structure.

'Sustainable European Ecological Identity'

How likely are we to meet the above challenges? The general expert view is that we can indeed observe a shift towards sustainable mobility. However given the slow pace of implementation of relevant policies (with regard to fuel prices, investment strategy etc.) and the likewise slow diffusion of innovations (for instance with regard to renewable energy) positive impacts in terms of environmental degradation or the re-balancing of modes is not expected to begin to happen prior to 2010.

The future which represents the most desirable state of affairs is that which capitalizes on the positive elements of the present and completely overcomes its negative aspects. This we have called the 'Sustainable European Ecological Identity' future scenario. Experts assess this as highly desirable but also as highly unlikely to materialize. This reflects pessimism in part but also pragmatism.

'Governance Failure'

The negative future which we have called 'Governance Failure' focuses on the negative elements of the present and expects these to become worse in the years to come. This is caused by the prolongation of economic recession in conjunction with technological breakdown. The reason for calling this negative future state of affairs 'governance failure' has to do with the failure of existing institutional arrangements to deal with negative developments.

The present situation is not such that we can lay back and rest assured that inevitably it will all turn out well. The slow down of the economy in conjunction with increasing social inequalities and the real loss of power of social and political institutions to effect change in the short-term contribute to the perceived instability and insecurity. Governance failure is not imminent but the tendency to substitute technocracy for governance is a real problem currently faced at both national and European levels.

Contextual Conditions

Contextual conditions facilitating progress along the paths established by the transport impact pathways include (a) a multilevel governance framework within which policy coordination and cooperation can be designed and implemented as well as (b) a social policy agenda that assists in the integration of economic, environmental and social objectives. These contextual conditions are largely independent from a policy domain like transport. However transport policy would be advised to follow a similar logic when designing long-term strategy.

Follow-Up

The knowledge gathered by the 'Foresight for Transport' project is of use for scrutinizing and thereafter refining policy implementation strategies as well as for elaborating long-term strategies in a strategic manner, i.e. in relation to other policies. Furthermore the information gathered can be used to improve the assumptions underlying strategic models thus contributing to the amelioration of the latter's projections and their better interpretation. The results of the 'Foresight for Transport' project are being used in this strategic manner in other consultancy and research work of the European Commission as well as by national and international transport policy communities.

Sources and References

www.iccr-international.org/foresight

The US Hydrogen Roadmap 2030

Authors:	Michael W. Chinworth/ michael.w.chinworth@vanderbilt.edu The VIPPS –Vanderbilt Institute for Public Policy Studies		
Sponsors:	The U.S. Department of Energy		
Type:	A National Foresight initiative focusing on hydrogen production, delivery and applications		
Organizer:	The U.S. Department of Energy		
Duration:	2002+	Budget: Not available	Time Horizon: 2010-2030

Purpose

The U.S. Department of Energy or DOE began sponsoring the development of a national hydrogen energy roadmap process in March 2002. Since its initial workshop, the DOE has released three separate but related reports outlining a strategy to assist the US in a transition from a petroleum based economy to one relying on hydrogen as its principle energy supply.

A Comprehensive Energy Policy

The National Energy Policy – issued in May 2001 – was the initial effort by the new Bush administration to form a comprehensive energy policy. The energy policy covered virtually every aspect and all forms of conventional and advanced energy production and consumption. Its sweeping nature reflected inputs by stakeholders in each of these areas. With regard to the emergence of a hydrogen-based, as opposed to petroleum-based economy, however, the National Energy Policy helped redirect a group of somewhat unrelated, ongoing programs within DOE to place greater importance on hydrogen research in the context of a comprehensive energy policy. The energy policy stimulated formation of a National Hydrogen Energy Roadmap that laid out a more systematic approach to implementing and coordinating hydrogen research projects within the Department of Energy and across other parts of the U.S. government.

The Roadmap

Concurrent with the development and public release of the National Energy Policy, the Department of Energy sponsored multiple workshops to attract inputs into the formation of a national "vision" on hydrogen in 2001-2002.

The Department of Energy convened a series of panels under the direction of industry experts to identify challenges in achieving the hydrogen economy. Panels received inputs from industry and academic specialists, national laboratories and company officials currently engaged in hydrogen-related activities. The panels also benefited from modelling and analytical work performed at the national laboratories under the energy Department's direction. These included system-level tradeoff analyses and assessments of infrastructure requirements. Comprehensive workshops were held in November 2001 and April 2002 to finalize details of the Roadmap and its underlying Vision. These inputs were used to form the National Hydrogen Energy Roadmap, a programmatic framework for addressing each of the critical elements in achieving this vision, including production, delivery, storage, conversion and application.

Over time and in part reflecting earlier priorities, programs evolving from this framework have centred on transportation and stationary/portable power generation. (Figure p. 85: 40 year lead-times)

Three Imperatives for the Hydrogen Economy

The Roadmap offered multiple observations and conclusions regarding the transition to a hydrogen economy. Three broad areas, however, stand out among them involving the scale of the task, the problem of achieving cost-effective production and the daunting problem of developing an infrastructure sufficient to deliver hydrogen to end users:

- **Technology development and system integration:** The roadmap counts heavily on government-industry partnerships to fulfil requirements. Hydrogen production today is limited to a few regions in the United States – mostly farm belt locations and coastal areas with high concentrations of oil refineries. Quantities reflect the currently specialized use of hydrogen in industrial production (although U.S. consumption reflects 20% of global hydrogen production today).

		2000 ⇢ 2040			
Public Policy Framework		• Security • Air Quality • Climate • H2 Safety ⇢ Outreach and acceptance		⇢ Public confidence in hydrogen as an energy carrier	
Hydrogen Industry Segments	Production	Advanced processing of natural gas ⇢ Gasification of biomass/ coal with sequestration ⇢ Electrolysis using renewable and nuclear Biological processes ⇢ Carbon sequestration ⇢ ⇢ ⇢ ⇢ Nuclear thermo-chemical water splitting			Photolytic water splitting Biological processes
	Delivery	• Pipelines • Trucks, rail, barges	Onsite “distributed” facilities		Integrated central-distributed networks
	Storage	Pressurized tanks (gases and liquids) ⇢ Solidstate ⇢ (Hydrides) ⇢ Chemical storage (methanol, diesel)		⇢ Mature technologies for mass production ⇢ Solid state (carbon, glass structures)	
	Concersion	Combustion	• Fuel cells • Advanced combustion	⇢ Mature technologies for mass production	
	Applications	• Fuel refining • Space shuttle • Portable power • Government stationary and fleet systems	• Stationary distributed power • Bus fleets • Vehicle fleets • Military	• Commercial fleets • Distributed CHP • Market introduction of personal vehicles	• Utility systems • Integrated fuel/power systems

- **Lower costs and greater efficiency:** Because many anticipated production technologies remain immature, the Roadmap supports broad development efforts for both central-station and distributed hydrogen production. The Roadmap called on efforts to focus on improving existing commercial processes such as steam methane reformation, multi-fuel gasification and electrolysis. Next-generation production technologies include biological and nuclear- or solar-powered thermo-chemical water-splitting.
- **Challenges posed by the delivery of hydrogen:** Current delivery systems reflect hydrogen’s localized production. Some 1,130 km of hydrogen pipelines exist across the United States today – a miniscule amount compared with over 290,000 km of natural gas pipelines currently in use. Construction of hydrogen pipelines using existing technology costs between $180,000 and $840,000 per kilometre – slightly more than twice the cost of natural gas pipeline construction.

Investing in the Value Chain

Bulk transportation, delivery and storage require capital investments in existing or near-term technologies, including hydrogen sensors, pipeline materials, compressors and high-pressure breakaway hoses. End-user delivery systems are more problematic due to immature market development, according to the Roadmap.

Producing the Earth’s Most Abundant Element

Although hydrogen is the most abundant element on earth, it must be produced. Steam methane reforming currently accounts for 95 percent of the hydrogen produced in the United States. It is the most energy efficient means of producing hydrogen in large quantities for bulk, industrial use.

The Roadmap anticipates that conversion of hydrogen into useful forms of electric and thermal energy involves use of fuel cells, reciprocating engines, turbines, and process heaters. Identification of candidate manufacturing technologies is a high early priority in the Roadmap.

There are no delusions in the Roadmap concerning the timeframe required to achieve a conversion to a hydrogen-based economy, even though several objectives might be considered optimistic. The transition is expected to require fifty years or more. Current planning, research and development activities are aimed at laying the groundwork necessary to begin that transition in earnest during the 2010-2030 period. This timeframe was underscored in DOE’s subsequent Hydrogen Posture Plan: An Integrated Research, Development and Demonstration Plan (February 2004).

These goals may still be ambitious, but are more realistic than earlier estimates. For example, the Partnership for a New Generation of Vehicles (PNGV) of the Clinton administration optimistically predicted PNGV prototype fuel cell vehicles to move into commercialization by 2005.

IMPACT

DOE Programs: Roadmap-Induced Discipline

The Hydrogen Roadmap has helped organized Energy Department programs under a coherent umbrella. The ambitious plans laid out in the Roadmap, however, have not been fully realized through federal funding. For example, total hydrogen and fuel cell R&D under the Energy Department’s Office of Science has grown from just $92.0 million in FY 2003 to $159.5 in FY 2005.

Rapid Growth but a Small Base

The growth rate is significant, but after allocating funds among the many and varied projects comprising the Roadmap, individual efforts experience diluted funding. Furthermore, for the last three years, budgets approved by Congress consistently have been roughly half the amounts requested by DOE agencies involved in hydrogen research programs. This is further complicated by the currently heavy emphasis on transportation aspects of the Roadmap, particularly introduction of hydrogen powered fuel cells.

FY 2003-05 Hydrogen and Fuel Cell R&D Funding by Activity			
Activity Fiscal Year	2003	2004	2005
Hydrogen technology			
Production/delivery	6.4	10.3	14.4
Storage	10.8	14.0	23.8
Infrastructure validation	3.0	5.9	9.6
Safety, codes & standards	2.6	3.9	3.4
Congressionally mandated projects	13.4	42.0	37.3
Fuel cell technology			
Transportation systems	6.1	7.5	7.5
Distributed energy systems	7.3	7.4	6.9
Fuel processing	23.5	14.8	9.7
Stack components	14.8	25.2	32.5
Technology validation	1.8	9.9	17.8
Technical/program support	0.4	0.4	0.5
Total	92.0	147.2	169.5

National laboratories under the Energy Department's jurisdiction share these funds but also are engaged in a variety of independent R&D activities as well as contract and cooperative R&D with industry partners. Funding for these arrangements sometimes fall outside of the budget of the DOE.

Energy Policy Act of 2005 – Authorized Funding Levels ($millions)					
Fiscal Year	2006	2007	2008	2009	2010
Research Area					
Hydrogen supply	160	200	220	230	250
Fuel cell technologies	150	160	170	180	200
Hydrogen/fuel cell demonstrations	185	200	250	300	375
Regulatory codes & standards	4	7	8	10	9
Total	499	567	648	720	834

The Funding Dearth

The funding outlook may be improved with the recent approval by Congress of the Energy Policy Act of 2005. Authorized funding for all hydrogen Roadmap R&D plans will increase from $499 million in FY 2006 to $834.0 million in FY 2010 – the point at which the Roadmap anticipates the beginning of greater commercialization of hydrogen technologies. These funds must be shared among individual projects. They also represent authorized ceilings. Actual funding levels will be determined by annual appropriations cycles. Finally, it is questionable whether funding levels are sufficient at an absolute level to achieve technical goals, although they may be sufficient to encourage the government-industry partnerships that are a centrepiece of the Roadmap.

Significant Pilot Projects

Two pilot programs could affect the prospects for realizing the Roadmap's ambitious goals. The first is **FutureGen** – an initiative announced in February 2003 to produce hydrogen from clean coal sources. The project received loan guarantees and other forms of funding support in the 2005 Energy Policy Act. Total direct funding was announced at $1.0 billion over ten years. Details of the program are outlined in Hydrogen from Coal Program: Research, Development and Demonstration Plan for the Period 2004 through 2015 (June 10, 2004). The second pilot – **the Nuclear Hydrogen R&D Plan** – was approved in the Energy Policy Act after many years of advocacy by some of the national laboratories. This will demonstrate hydrogen production using a high temperature nuclear gas reactor. Plans call for combined electricity and hydrogen production by 2017. The program is further detailed in the Nuclear Hydrogen R&D Plan of the DOE (March 2004). This pilot falls under the DOE Office of Nuclear Energy, Science & Technology and is part of a broader program to identify and test next generation nuclear reactors.

National Labs - High Ambitions but Funding Uncertainties

National laboratories under direction of the DOE were important players in influencing the development of the Roadmap, in part because of research projects and analytical studies performed prior to its publication. National laboratory activities are funded through a combination of sources, including:

- DOE budgets,
- Independent research and development,
- Contract research funds from other government agencies,
- Cooperative research contracts with industry.

This funding variety has contributed to a diversity of research projects, although sufficiency of funding may yet be an issue.

Good Intentions but Few Resources

The Hydrogen Roadmap by its nature is a political guide but nevertheless has been important in helping develop a long-term agenda toward diversifying clean and reliable fuel sources for multiple applications. The difficulty facing the Roadmap – particularly given the long timeframes necessary to achieve significant technical results and technology development – is in matching appropriate funding to its ambitious goals. With this in mind, three broad conclusions can be offered concerning the Roadmap, its impact and prospects:

- The Hydrogen Roadmap has been successful to the extent that it has helped policymakers and government research organizations consolidate and articulate their programs under a comprehensive philosophy toward bringing the hydrogen economy to fruition. Various hydrogen research projects had been under way with DOE support for more than a decade prior to conclusion of the Roadmap. Most of the projects applied to transportation applications under programs that had mixed results. Other aspects relating to production, delivery and applications, while not lost within DOE, nevertheless lacked context. The Roadmap has provided that context.
- Many ambitious program goals may be betrayed by less than generous funding by Congress. While the Roadmap provides context, direction and objectives, its goals may not be achieved due to relatively low congressional funding.
- Government-industry partnership programs could influence the future direction of specific aspects of the Roadmap. Newly introduced pilot projects could influence long-term government funding. Funding support and subsidies provided the FutureGen and nuclear-hydrogen production pilot project could help these projects achieve their respective technical performance and technology development goals (cost effectiveness is another matter, one that is not considered here). Should these pilots demonstrate successful results, they could influence future investment and funding decisions, and thus the overall direction of the Roadmap.

Sources and References

- http://www.hydrogen.energy.gov/ [Department of Energy hydrogen program home page]
- http://www.eere.energy.gov/hydrogenandfuelcells/mypp/ [long-term R&D plans]
- http://hydrogen.gov/ [information gateway for presidential level coordinating activities]
- National Energy Policy Development Group (May 2001): National Energy Policy.
- The Department of Energy (February 2002): A National Vision of America’s Transition to a Hydrogen Economy – To 2030 and Beyond.
- The Department of Energy (November 2002): National Hydrogen Energy Roadmap.
- The Department of Energy, Office of Science (May 2003): Basic Research Needs for the Hydrogen Economy.

Transition to Sustainable Production Systems - Austria 2020

Authors:	Matthias Weber of ARC systems research/ matthias.weber@arcs.ac.at
Sponsors:	Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT)
Type:	National sectoral foresight linked to a research programme on sustainable manufacturing entitled "The Factory of Tomorrow"
Organizer:	ARC systems research in Vienna Contact Matthias Weber of ARC systems research The IFF/IFZ in Graz For further contact go to the project site / www.fabrikderzukunft.at
Duration:	2003 – 2005 | Budget: € 200 000 | Time Horizon: 2015-2020

Overview

As part of the Federal Austrian Research Programme "Factory of Tomorrow", the project "Transition to Sustainable Production Systems" served to explore possible future pathways in selected areas of sustainable production. Based on the development of future scenarios for the areas of 'bio-refineries' and 'wood-plastic-composites/biopolymers', strategic options for research, industry and 'policy were explored. A particular emphasis was put on the role of RTD-policy.

Managing Transitions to Sustainable Production Consumption Systems

The 'Transition to Sustainable Production Systems' project is a forward looking accompanying measure funded by the Austrian national research programme 'The Factory of Tomorrow'. It aims to contribute to the further development of the programme in terms of strategic and thematic orientation, as well as to the wider debate about coordination between research and technology policy on the one hand and sustainability policy on the other. Moreover, as it is necessary for a small country to concentrate on selected areas of research and technology development, impulses from programmes in that field need to be focused on some promising areas; in this specific case by selecting and focusing on the transition of some specific production and consumption systems towards sustainability. The contribution of research and technology programmes to long term transition strategies towards sustainable production is investigated at two levels:

- First, recommendations for the conceptualization of and priority-setting within sustainable technology programmes are developed.
- Secondly, based on the example of two selected transition fields, the potential for a strategic reshaping of production and consumption systems towards sustainability is explored, together with an assessment of the potential contribution of public RTD programmes and of the coordination needs with other policies and actors.

The two transition fields selected for this project concentrate on the production-consumption systems related to:

- Bio-refineries, and to
- Wood-plastic-composites and bio-polymers (WPCs).

More specifically, the objectives of this forward-looking project have been:

- To develop socio-technical scenarios of transition processes towards sustainability-oriented production and consumption systems for two selected transition fields.
- To provide orientation for future research and technology policy measures as well as for other relevant policy fields by developing 'guiding visions' at the level of transition fields.
- To generalize the results with respect to research and technology policy strategies and programmes and transfer to other transition fields.
- To support learning and community building in the two transition fields under investigation.

Transition Fields as Point of Departure for Change

The strategic approach behind this foresight project is inspired by the concept of 'Transition Management'. Transition Management understands transformations towards sustainability as long-term systemic processes which cannot be governed in a centralistic or hierarchical way but whose success requires long-term coordinated and

distributed learning processes at the levels of socio-technical niches, regimes and landscapes. Transitions presuppose system innovations which - beside technological innovations - include organizational, social and institutional changes to support the uptake and adjustment of sustainable technologies.
By focusing on specific transition fields – in this case on bio-refineries and WPCs, a link can be established between concrete technology projects on the one hand and general sustainability goals and visions on the other.

In contrast to energy supply, water management or transport, heterogeneous areas like production require the investigation of transitions in comparatively narrow fields. In particular, by specifying general visions of sustainable production and by combining them with technological developments in the transition fields it is possible to identify concrete interdependencies between technological opportunities, user needs and institutional environments.

Scenarios at the level of the transitions fields have been developed in a participative process with participants in the programme 'The Factory of Tomorrow' and with other stakeholders such as firms, research institutes, policy-makers and associations, in order to create a common orientation towards future development of these fields. In a first exploratory workshop key influential factors have been identified and combined to storylines that gave subsequently rise to different framework scenarios. In the two following workshops these scenarios have been further elaborated and assessed with regard to their impacts on sustainability, in terms of promising R&D strategies, and in terms of needs or opportunities for robust and adaptive policy strategies.

Towards Sustainable Production Systems

Bio-refineries as a New Production Model

Bio-refineries are integrated systems that combine physical, chemical and/or biotechnological processes and plants in which biogenic raw material of different origins is processed into a whole range of industrial intermediates and/or final products. It is the hope of advocates of the bio-refinery concept that these technologies and production concepts brought together under this notion will fundamentally transform the production process of many industrial goods, once they are adopted by industry.

With the concept of the bio-refinery it seems possible to substitute an increasing share of fossil – with its increasing scarcity and price volatility – with biogenic raw materials thus reduce CO_2 emissions and other negative environmental effects of fossil fuel consumption. Moreover, it is argued that in addition to the energy and resource efficiencies they provide, bio-refineries will gain importance because they provide opportunities to produce completely new products with qualities desired by consumers that go beyond bio-degradability but that cannot be provided on the basis of petroleum based products.

However, it is still far from clear which broader scenarios would be compatible with and conducive for an uptake of bio-refineries, what the specific conditions for a successful diffusion would be, and whether they would indeed contribute to the transformation of the production system towards sustainability. In Austria, for instance, decentralized and small-scale 'green bio-refineries' have been considered to be a promising and sustainable concept.

Scenarios for the First 'Transition Field' Bio-refineries

Three scenarios about the future application of bio-refineries in Austria have been developed together with stakeholders interested in relevant fields of R&D or in the possible application of the bio-refinery concept:

The first scenario called **'Made in Styria'** features conditions for the close cooperation of regional actors (local industry, farmers etc.) who implement a decentralized form of bio-refinery adapted to regional conditions, strongly supported by active and integrated policies in favor of sustainable agriculture and substitution of fossil resources.

The second scenario named **'Big players push for bio-refineries'** suggests that trans-national companies could adopt the concept at a large scale: They could invest in own R&D efforts, realize big scale centralized plants and would probably buy standardized biomass at low prices from agriculture in the wider region as well as from the international market.

In the third scenario entitled **'Following on from bio-energy'**, the production concept of the bio-refinery is realized as a consequence of developments in the energy system. Due to the widespread operation of bio-energy plants for biogas and biomass combustion as well as the existence of an extensive infrastructure for distribution, the separation of specific biomass fractions to be processed in bio-refineries as a chemical feedstock and use of the remaining biomaterial for energy generation can be achieved at very low additional cost.

These scenarios were assessed with regard to the opportunities and threats associated to them, especially with regard to the sustainability of these production systems. A special focus was put on barriers and systemic effects, prerequisites and critical framework conditions for the realization of the more sustainable versions of the most likely developments.

For instance, the future of bio-refineries depends heavily on adequate EU policies in the fields of agriculture and the use of resources, and on a supportive framework in industrial, structural, and regional development policies.

Detailed plans for required R&D activities were drawn up, including important features of instruments for strategy development, network building and R&D support by the participants of the workshops themselves.

Scenarios for the Second 'Transition Field' WPCs and Biopolymers

Wood plastic composites (WPCs) and bio-polymers became the subject of the second pilot transition field, because they are an example of a renewable resource and they involve growing R&D activities in Austria. The three scenarios developed for this cluster of technologies differ in terms of framework conditions and the degree of innovation that is achieved with WPCs and biopolymers:

The first scenario is called **'Substitution Pays off – WPCs'**. It is based on the observation that WPCs are already in use in some applications. In the context of this scenario the future potential of wood plastic composites (WPCs) could be exploited particularly due to rising prices of crude oil.

Increasingly, enterprises start to replace conventional plastics by WPCs. Where technical characteristics, weight and geometry are of importance, likewise, wood is substituted in some applications. However, R&D efforts predominantly concentrate on the development of WPCs to substitute plastic products. To some extent, also wood products are being replaced. The presence of R&D actors, producers, suppliers of equipment and customers in Austria, many of whom are networked through a competence centre, gives justified hope to maintain technological leadership.

The second scenario **'Substitution Pays off – biopolymers'** concentrates on the perspectives for biopolymers. It also assumes a high level of crude oil prices, but the success of the scenario depends on coordinated efforts of agriculture to provide the raw materials for biopolymers. In the medium term, a major potential for the use of bio polymers exists in biodegradable packaging. Assuming political support from agricultural policy and environmental policy, the Austrian industry can position itself in global niches. In the long term, however, also product properties gain importance, which cover long-lasting and technologically new products, since the market potential for purely biologically degradable biopolymers is limited.

The third scenario **'Lighthouse Products with Appeal'** emphasizes the 'trend-setting character' of new applications and products based on the new materials and the importance of demand orientation. Advanced applications of the 'new materials' are being developed, that are used in innovative products. The success of the scenario is based on making use of special properties of these materials, and on the buyers' emotional perception of well-designed and marketed products.

This special appeal requires major efforts in product development, marketing and image development in order to boost the demand for the new materials.

Similar to the case of bio-refineries an assessment of opportunities and risks was conducted for all three scenarios. The evaluation of the sustainable development in connection with the scenarios was accomplished in six categories:

- The Economy,
- Employment,
- The environment,
- Regional development,
- Knowledge, and
- Networks.

Moreover, the feasibility of the scenarios was evaluated by experts and participants.

Improving the Design Process for a Transition to Sustainability

Apart from the specific recommendations for the perspectives and the future shaping of the two transition fields, conclusions were drawn with respect to the design of research and technology programmes for sustainability, and in particular for the further development of the programme 'The Factory of Tomorrow'.

The concept of focusing on the development of **'beacons'** as a guiding principle of the programme shall be linked with systemic considerations to assure the integration with other policy measures which are of importance for the mid- to long-term perspectives of the topics addressed by the programme.

The link to international developments could be further improved in the case of the two selected fields, but most likely also in other areas.

A broadening of the perspective would have been supportive to develop more realistic concepts for the future of these technology fields in Austria. ERA-Net initiatives have started to assure such an international perspective at the strategic programme level, but this is not yet sufficiently developed at the level of individual projects.

In accordance with the transition perspective but also with the 'beacon' concept the continuity of thematic fields within the programme is of major importance to provide long term incentives.

The systematic identification, accompanying evaluation and where necessary the closing down of key topics should be standard elements of any such programme.

In spite of the necessity to focus on key areas and key tasks, considerations relating to the sectoral specificities should be taken into account more prominently when defining technology-oriented programmes and exploring interdependencies with other policy areas.

The transition perspective and the methodology of participative scenario development have helped to establish a link between the strategic orientation of a research programme and the more comprehensive sustainability strategies that are central to other policy domains.

However, beyond the level of individual programmes, the developed methodology can serve to support research and technology policy at different levels and in different phases of the political process. It promises to be particularly helpful for the design phase of RTD programmes for example by maintaining a focus on thematic areas that are not only desirable but realistic in terms of their systemic development potential.

This design phase requires interaction between 'bottom up' mechanisms for the generation of new ideas and 'top down' activities of subsequent focusing, i.e. a pattern that is characteristic of the participative development of socio-technical scenarios from transition perspectives.

For the project at hand, 'transition fields' have been considered and applied in the context of research and technology programmes. However, this approach could also be applied at the level of national strategies for research, technology and innovation policy.

Sources and References

The Final report will be made available soon at:
http://www.fabrikderzukunft.at

Cognitive Systems 2020

Authors:	Jane Jackson/ jane.jackson@dti.gsi.gov.uk		
Sponsors:	Department of Trade and Industry		
Type:	A national foresight project covering a particular issue and the S&T and socio-economic fields that on which it impacts and which impact on it.		
Organizer:	Foresight Directorate, Office of Science and Technology/ www.foresight.gov.uk		
Duration:	2002 – 2003	Budget: € 660 000	Time Horizon: 2020

Motivation

The objective of the UK Cognitive Systems Project was to produce a vision for the future development of cognitive systems through an exploration of recent advances in neuroscience, computer science and related fields, and their potential for future interaction.

Creating Dialogue between Activities in Biological and Artificial Cognition

The UK Foresight programme is a rolling programme of focused projects. ‘Cognitive Systems’ was one of the two pilot projects created when UK Foresight moved from a general panel based approach looking at all areas of science and technology to the more focused issues based projects. ‘Cognitive Systems’ was selected because it is an area of research where the challenges were such that different disciplines might profitably work together more effectively than in the past.

Cognitive systems are natural or artificial information processing systems, including those responsible for perception, learning, reasoning, decision-making, communication and action.

The objectives of the project were to:

- Examine recent progress in two major areas of research - artificial and living cognitive systems - and their related disciplines (including computer science, neuroscience, cognitive science, artificial intelligence) - to understand whether progress in understanding cognition in living systems has new insights to offer those researching the construction of artificial cognitive systems;
- Scope the likely developments in these fields over the next decade, and in particular to scope the likely rate of progress in our capability to build artificial cognitive systems;
- Articulate significant conclusions from this to a wider audience.

The Foresight Approach

Lord Sainsbury, science minister at the Department of Trade and Industry, chaired the stakeholder group which oversaw the project. Membership included business, academia and government.

The project explored the objectives using a variety of tools and mechanisms. As one of the first projects following the reshaping of Foresight, the project initiated a number of methods which have become the norm in subsequent projects. The project was supported by a small team within Foresight, and employed two leading experts – one in the field of neuroscience and the other in computer engineering to steer the project’s exploration of the objectives, particularly in the relevant science and technology. A series of workshops defined the scope of the project and identified topics for eleven science reviews which fed into four grand challenges, presented at the InterAction Conference in September 2003.

The results of the conference and the reviews and challenges form the basis of the project’s action plan aimed at taking forward the findings of the project and formalising the post project process which included the reconvening of the stakeholder group a year after the project finished.

Synergies between the Life Sciences & the Physical Sciences

In the life sciences, brain research benefits greatly from advances in technologies that can begin to monitor brain activity in ‘real time’ and at ever greater resolution. IT also continues to progress as ever declining costs, improved performance and mobile devices make massive amounts of computing power available to more users. The challenge for the future is how to make best use of it.

Research Challenges

In both the life sciences and physical sciences, progress may be rapid but there are challenges at a fundamental level.

In the case of IT, conventional ‘engineering’ approaches to problem solving are running into difficulties. For example, we will not be able to move from speech recognition to natural dialogue with machines simply by throwing computer power at the problem.

For its part, brain science could benefit from information processing techniques that are widely deployed in IT.

Researchers also need better techniques for measurement and analysis.

Addressing Public and Scientific Communities

Both areas also face a common challenge in explaining their work to wider audiences. Without an appreciation of what researchers hope to achieve, and how society can benefit from their work, it will be all too easy to lose public acceptance.

One task during the project was to elicit the views of the research communities involved. In particular, it was important to see if they agreed that there could be fruitful discussions between life scientists and researchers in computer science.

From the outset, the scientific community itself was in the driving seat for the project. The Foresight Directorate was the facilitator of a dialogue between, and within, the research communities.

The technical aspects of the project were in the hands of two scientific experts, one as the coordinator for the physical sciences and as coordinator for the life sciences. Both continued in these roles after the project formally ended.

Rising to the Challenge

Research Manifestos can Guide the Scientific Agenda

The project commissioned researchers, brought together from the life sciences and physical sciences, to develop proposals for areas of science that could benefit from fertilisation of ideas across traditional disciplinary boundaries. Known within the project as ‘Grand Challenges’, Foresight’s challenges share the ambition of the UK Computing Research Committee that “The grand challenge should be directed towards a revolutionary advance, rather than the evolutionary improvement of legacy products that is appropriate for industrial funding and support.” The Foresight commissions also shared the belief that “The ambition of a grand challenge can be far greater than what can be achieved by a single research team in the span of a single research grant.” Building on the Research Reviews commissioned for the project, the OST commissioned groups to work up Grand Challenges on:

- Memories for life, which includes the use of cognitive engineering to offset memory loss due to aging or disease,
- Localisation in animals and artificial systems,
- The role of rhythmic activity in the brain,
- Neuro-computational approaches to speech and language.

The Department of Trade and Industry commissioned these reviews as representative proposals for presentation at the InterAction Conference. Many more ideas came up at the Foresight workshops.

The project has shown that a dialogue between life scientists and physical scientists can provide valuable insights into the future direction of research into cognitive systems. It has also shown that researchers in these areas are enthusiastic about the possibilities of collaboration, and are keen to move ahead.

Key Issues to be Considered

The project identified a number of issues for further attention:

- **Facilities:** Brain research depends increasingly on access to large and expensive equipment, for functional magnetic resonance imaging, for example. Any follow up to the foresight project should consider the case for such facilities.
- **Training:** Future research in cognitive systems will need contributions from researchers who are comfortable working across traditional disciplinary boundaries while still being experts in their own field. This could be encouraged through “cross discipline” PhD students with supervisors from the life sciences and physical sciences. For established researchers, fellowships could provide opportunities for life scientists to acquire knowledge of the physical sciences, and vice versa.
- **Funding:** The Cognitive Systems Project has shown that there are exciting opportunities in research across

disciplinary boundaries. While there is certainly a case for investigating the possibility of further funding mechanisms, the Research Councils and other organisations have already shown interest in discipline breaking research and are likely to reflect this in future funding decisions.

The project did highlight the need to enable cross-disciplinary proposals to be assessed on equal terms with proposals of more traditional structure. The community is working to overcome some barriers, by creating a pool of referees, for example.

- **Public Debate:** Research in natural and artificial cognitive systems has enormous social implications. If society is to appreciate the possibilities, to accept novel applications and technologies and to influence their development, it is important to debate the issues in advance.

New Directions for Research

With no promise of funding, the community ran five cross disciplinary workshops to see if it would be possible to draw up high quality cross disciplinary proposals in five key areas identified by the project. Costs for the venues were covered by Foresight and Engineering and Physical Sciences Research Council. Over 150 scientists were involved in these workshops. One group has also written an additional state of science review on an area not covered by the main project – robotics.

In parallel, the Wellcome Trust offered funding to take forward research on cognitive systems if it was match funded. This provided the basis for a discussion with the Research Councils on how best to support research in this area.

In response, four Research Councils together with the Wellcome Trust issued a highlight notice seeking cross disciplinary proposals in response to the cognitive systems project. Fifteen proposals have already been received. There is also specific encouragement for bids on cognitive systems under the Medical Research Council/EPSRC discipline hopper scheme.

Widening Interest in Collaboration on Research on Cognitive Systems

A network has been set up on memories for life funded by the EPSRC and led by a small group who were involved in the project.

The Royal Society of Arts is using the information from the reports as the basis for a Design Competition it is running with the Royal College of Arts.

The British Computer Society has run a series of three meetings to foster debate with a wider community of scientists and business people. The BCS commented that there was no way that you would have got such eminent people from both communities involved in a meeting of this type if it had not been for the Foresight project.

Ongoing Activities

The project has highlighted the potential social implications of cognitive systems. The Royal Society, British Association, Royal Academy of Engineering and Academy for Medical Science have drawn up a proposal to explore the potential future social ethical and legal implications of cognitive systems. Their aim was to trial a process which might have wider application for future emerging technologies so there could be public engagement at the early stage of the development of new emerging area of science.

The Council for Science and Technology has asked that an assessment should be made of whether:

- The project approach is adopted by others to nurture emerging cross disciplinary research,
- The innovative interdisciplinary appraisal method introduced by the Research Councils and the Wellcome Trust leads to high quality projects within the current funding mechanism, and
- Projects of this type are a good base for public engagement on emerging areas of science.

These longer term outcomes will be assessed in two years.

Sources and References

All the above information is based on the Foresight Cognitive Systems reports which are available at
www.foresight.gov.uk

UK Foresight on Exploiting the Electro-Magnetic Spectrum 2020

Authors:	Jane Jackson/ jane.jackson@dti.gsi.gov.uk		
Sponsors:	Department of Trade and Industry		
Type:	A national foresight project covering a particular issue and the S&T and socio-economic fields that on which it impacts and which impact on it.		
Organizer:	Foresight Directorate, Office of Science and Technology/ www.foresight.gov.uk		
Duration:	2002 – 2003	Budget: € 660 000	Time Horizon: 2020

Motivation

The objective of the UK Foresight Project entitled EEMS - 'Exploiting the Electro-Magnetic Spectrum' was to provide a vision for the future exploitation of the electromagnetic spectrum to ensure increased UK innovation in related areas. Technologies that 'exploit' the Electro-Magnetic Spectrum include lasers, X-rays and other medical technologies as well as technologies for communication, the miniaturization of complex micro-systems, sensing, imaging as well as security.

Why the Electromagnetic Spectrum?

The UK Foresight programme is a rolling programme of focused foresight projects. Exploiting the Electromagnetic Spectrum (EEMS) emerged as an important issue based on a consultation exercise on the conclusions of a workshop of eminent scientists.

The electromagnetic spectrum is the subject of a great range of adventurous scientific research and is provides the basis for a wide range of vitally important technologies in areas as diverse as:
- Communications,
- Health, and
- Security.

The UK has a long history of world-leading research on the exploitation of the Electromagnetic Spectrum. Nevertheless the UK has not always moved from invention to application to reap commercial rewards from its discoveries.

The EEMS project formed part of a much wider effort across government to improve innovation and ensure that the UK captures more of these opportunities in the future.

The aim of EEMS as set out at the start of the project was to:
- Identify key areas of long term commercial opportunity across the electromagnetic spectrum,
- Assess these against UK capability, and
- Agree an action plan to help the UK exploit these areas.

The Foresight Approach

Stephen Timms and later on Alun Michael at the Department of Trade and Industry chaired the stakeholder group which oversaw the project. Membership of the stakeholder group included representatives from business, academia and government.

The project used a variety of tools and mechanisms such as workshops and action groups. It was supported by a small team within the UK Foresight programme and employed a leading expert in the field.

A rigorous scoping process was conducted involving the academic, business, and user communities along with representatives from other government departments and funding bodies.

Strategic Orientations

From Optical-Fibers to Meta-Materials

The scoping phase culminated in the selection of the four topics based around two workshops. The first workshop focused on the science push and identified 20 areas of research with application potential. The second workshop focused on the market pulls for the technologies identified by the first workshop. This resulted in a shortlist of nine topics where there was felt to be both a clear market demand, and hence exploitation opportunity, and a strong UK research base from which to start. Four of these were selected against the following criteria:

- Far-out so as to become a major economic activity 10–20 years hence,
- Innovative so as to represent a step-change to new technology,
- Of economic significance,
- Correspond to a UK capacity for exploitation,
- Constitute a balanced topic portfolio.

Those selected were:

- All-optical data handling,
- Photonics at the molecular level,
- Electro-Magnetic applications in the near field,
- Non-intrusive imaging.

The Foresight team convened action groups for each of these topic areas to identify the technical challenges and business opportunities, and develop plans for action. Members were drawn from business, academia, user communities, government and other agencies.

Preparatory Work

The action groups were provided with three sets of information to help them map out the most promising markets and applications for the UK to exploit, and the technological development needed to deliver those applications. The Foresight team commissioned:

- State of the science reviews for each topic, These looked at new technological advances, assessed likely impacts over the next 10–20 years and evaluated the UK's relative strengths in these areas,
- An easy-to-use evaluation tool to help assess potential investments in research and development based on real options methods, which allowed a broad comparison of potential returns from investment in different areas of research,
- An assessment carried out by a market research company, of the potential market sizes for the applications identified by the action groups as offering the greatest potential.

In selecting key opportunities from the many possibilities identified, the groups also considered competition both from other countries and other technologies in meeting the demand, and the investment costs needed to get to market.

Main Conclusions

The following highlights these opportunities and the main challenges to their realization:

Prospects of All-optical Data Handling

Optical fiber has become the dominant long-distance transmission medium for data communications, but routing and switching continues to be carried out electronically. If widespread demand reaches terabit level optical techniques will need to form an increasingly large part of switching and routing systems in order to satisfy expected future-traffic levels. The UK could capture a market of up to € 0.4 billion in 10 years' time in fast optical switches, if it invested now to build upon its excellent scientific expertise in the area. This is a high-risk venture because of:

- The uncertainty over the future need for fast optical switches,
- The likely global competition, and the risk that
- The UK will not have a significant home market.

The decision to roll out high-rate broadband-for-all rests upon wider economic and social considerations, but if taken now, it would offer the chance that the UK might also capture the commercial opportunities.

Photonics at the Molecular Level

Laser micro-machining in three dimensions offers many manufacturing opportunities such as the:

- Fabrication of micro-structured materials for next-generation solar cells,
- Smart fibers,
- Photonic crystals, and
- Photonic lab-on-a-chip devices.

The UK could capture a €4 billion market in integrated lab-on-a-chip systems, as a platform technology for a range of multi-diagnostic applications and in the longer term these could lead to therapeutic applications.

Extrapolating the historical market growth rate and current size, the market could be €100 billion by 2012. Capturing even 5% of this is a significant opportunity that the UK is in a strong research position to pursue.

These applications tend to have high capital costs of setting up production, but the potentially huge markets mean that the relatively low initial research investment costs are an attractive, if risky, proposition.

'Near Field' Electro-Magnetic Applications

The 'near field' refers to the confined non-propagating part of the electromagnetic field that decays away exponentially from the surface and becomes insignificant within a distance of about one wavelength.

The recent UK led discovery of 'meta-materials' (otherwise known as 'composite artificial materials') allows the manipulation of the near field in ways not previously possible.

Near-field technologies are critical for the development of smart antennae, integrated radio frequency infrastructure and circuitry.

The UK has a strong industry presence in this sector and there is already much short-term incremental development. Meta-materials are opening exciting new possibilities in areas such as sub-wavelength resolution imaging using 'super-lenses', especially in magnetic resonance imaging. As yet, there are no obvious single applications that alone would be of sufficient potential to justify immediate commercial investment. More basic research is needed to explore the full potential of these meta-materials.

Non-intrusive Imaging

The technologies have applications in both healthcare and security.

Smart chemical agents can act as 'tags' to indicate disease by showing up when the patient is imaged. They offer the prospect of high specificity molecular imaging for the early non-intrusive detection of diseases like

- Cancer,
- Vascular conditions,
- Neurodegenerative and neurological conditions.

The UK could capture a €5 billion share of the market for smart agents for medical imaging. Detection of weapons and explosives at a distance, using safe, reliable and cheap technology, is a growing requirement in today's world. The UK is in a leading position in developing security imaging using combinations of frequencies from millimeter waves through terahertz to infrared.

A key enabler for UK businesses to capture a €0.3 billion share of the market would be the provision of a national foundry to enable companies to prototype their inventions fast and in a secure Intellectual Property (IP) environment.

Linking Vision with Action

Innovation and the Diffusion of Knowledge

Common key facilitators of innovation that emerged across all areas were:

- The National or in some cases the EU level coordination of activities,
- Strong industry lead multidisciplinary teams,
- Centers to bring together industry and academia to work on short focused programmes to solve specific challenges,
- Establishing a clear and acceptable means of protecting IP in order to facilitate businesses sharing facilities in these collaborative projects.

Impact on Activities of the R&D Community

The project's findings influenced the choice of bids submitted to the DTI Technology Strategy Board, with the November 2004 competition of the Technology Programme supporting:

Opto-electronics and Disruptive Electronic Imaging Technologies: These areas received many project applications relevant to areas identified by EEMS and support for projects relevant to these areas is estimated to be approximately €12m. The April 2005 competition has supported a further EEMS relevant topic, covering next generation lasers in manufacturing, healthcare and security.

Research Councils: The findings were presented to the council of the Engineering and Physical Sciences Research Council (EPSRC) in 2004 and EPSRC has supported over 100 research proposals in the field covered by EEMS in excess of €55m. In April 2005 a further €3m was awarded in research grants and further proposals to the value of €15m are currently under consideration.

Photonics is especially well represented, with two portfolio partnerships in Nano-photonics and Photonics (€5m and €11m respectively) awarded to Southampton University and €4m awarded to Bath University for research into photonic crystal fibers.

Strengthening Communities of Interest: The EEMS has led to the development and reinforcement of a number of networks that continue to explore the findings of the project.

The 'Real Options' Model: The real options model has generated considerable interest in DTI and in the DTI Economists' network in the use of tools of this type to support long-term strategic investment decisions. The Council for Science and Technology has as a consequence, reviewed the use of such approaches and has made recommendations to DTI about their use.

Network on Coherent X-Rays: Coherent x-rays was one of the six topics identified as important and included on the shortlist for EEMS, but it was not chosen for the final report. The National Physical Laboratory (NPL) took this area forward at a seminar on 2 June 2004. Attendees identified collaboration between accelerator-based physicists and those who use table-top lasers as a key area to take forward from this meeting.

Metrology Conference: The NPL hosted a conference on Precision Electromagnetic Measurements in London from 27

June – 2 July 2004, with over 500 international delegates, at which the EEMS findings were reported. This encouraged the formation of a project on attosecond laser technology at NPL as part of the 2004-2007 Quantum Programme.

The impact of ICT on Healthcare: The Royal Society has used the findings of the medical imaging component of the EEMS project to inform their new study into pervasive healthcare in the future.

Medical Imaging Network: NPL, Department of Health, EPSRC, Biology and Biological Sciences Research Council and Medical Research Council all strongly supported the creation of a medical imaging network. The DTI is taking this forward through the Faraday Review process.

Impact on the Activities of Government Organisations

The Ministry of Defense: The MoD has offered support for collaborative work in the field of meta-materials. It remains engaged and is considering further activity through the Joint Grant Scheme. The Defense Scientific Advisory Council technology board has also identified the compact personal health monitoring topic as a top priority for future research.

OfCom: The pervasive radio frequency area of EEMS is a key topic for OfCom and their Spectrum Advisory Board. They have considered the long-term implications for regulation of developments in this technology and it is likely that this will lead to a series of research and development projects.

Sources and References

All the above information is based on the Foresight exploiting the Electromagnetic Spectrum reports which are available at **www.foresight.gov.uk**

Operation FutuRIS – France 2020

Authors:	Isabelle Chatrie of Louis Lengrand and Associés/ isa@ll-a.fr Julie Rachidy of Louis Lengrand and Associés/ julie@ll-a.fr		
Sponsors:	Public organisations, research centres and private companies		
Type:	National foresight exercise		
Organizer:	The ANRT - Association Nationale de la Recherche Technique		
Duration:	2003 to 2005	Budget: € 4M	Time Horizon: 2020

Motivation

Operation FutuRIS is the result of an initiative launched by the French Association for Technical Research (ANRT) to bring together leading players of the public and private sectors with the aim of laying the foundations for the future of the French Research and Innovation System. FutuRIS is a systemic foresight exercise that uses a number of exploratory scenarios to simulate potential changes from which key issues can then be identified.

How Will the French Research and Innovation System Meet the Needs of Society?

The French Research and Innovation System was established after the Second World War. Today, the field of knowledge has widened and the French economy now operates as a part of the European and global economies. The current system has made it possible for France to stake a claim in several major markets. With the exception of microelectronics however the existing system has produced far less satisfactory results in the area of information technologies.

There are increasing doubts as to the ability of the current Research and Innovation System to meet the needs of French society in the future. Reasons for this are related at least in part to changes that have occurred in the political, economic, social and technological context over the past fifty years. Rather than restricting the foresight exercise to a critical review of the present situation of the French Research and Innovation System, FutuRIS is intended to analyze the challenges the system is likely to face in the period 2000 to 2020. It uses a foresight approach to look at a relatively wide range of possibilities for the future.

The three main objectives of this foresight exercise are to:
- Define France's strengths and weaknesses and the main trends in innovation,
- Identify the central principle that will drive the evolution of the French research and innovation system in the period 2015-2020,
- Make proposals for improvement of the system based on laws for the orientation and programming of research.

A Cooperative Approach

The exercise is organized by means of a **Steering Committee** that comprises 25 members coming from the research and education community, enterprises, public sector and society, an **Orientation Committee** which is effectively a consultative team to supports and validate the work of the operational team on a regular basis, as well as a **Central Team** in charge of executive work and a **College** which has a dialogue function.
Four expert working groups – **'Groupes Défis'** or 'Challenge Groups' - were established to discuss the following issues:
- Scientific and technological excellence for the future,
- Competitiveness through research and innovation,
- Interaction between research, innovation and the citizen,
- Dynamics of the French Research and Innovation System.

They each comprise about 25 members and meet once a month. Their main tasks are to identify key variables on the respective topics, to formulate hypotheses or principles for the evolution of the system as well as emergence of discontinuities in its evolution, and build mezzo-scenarios with a 15 year time horizon. Data, reports and roadmaps are collected through a wide network of correspondents that consist of about 150 experts who mainly interact through electronic means.

After the initial 3 month period of implementation a 2 year-exercise was planned as follows:
- A production phase from May to September 2003 in which key variables would be identified and analyzed,
- A consolidation phase from October to December 2003

in which scenarios were built through the development of evolutionary hypotheses, the identification of mezzo- and macro-scenarios and discussion with networks of correspondents all of which concluded with a large seminar in order to discuss the scenarios,
- A validation phase from January to February 2004, in which the work was finalized with a major closing conference that led into a second year of broad consultation,
- A consensus phase in 2005 in which the results were widely discussed with stakeholders.

Focus on the Social Value of Research and Innovation

Results of research and innovation contribute to meet social needs especially by improving social well-being. This point is particularly relevant in European societies with low levels of population growth and high levels of fixed capital because the increase in revenue mainly comes from intangible investments in research, innovation, education and training. According to economic experts, it is possible to envisage that unemployment, compounded by the rising number of pensioners (2010-2020), might lead to an explosion in social spending that would result in the breakdown of the current system, assuming that economic and social systems remain unchanged and that the economy does not return to sustained growth.

On the other hand, changes in democracy will continue to transform the relationships between science, technology, and society. It will no longer be just a matter of keeping citizens informed of developments in science and technology. Instead, it will be necessary to incorporate research and innovation into the interaction between scientific, political, economic, and social trends. Beyond questions on the existence of a basic consensus regarding values, behaviours may result in differences of opinion as to what is at stake, which would create major tensions. In this sense, group 3 (interaction of research and innovation with society) concluded that: "reviving ambitious innovation policies requires an open and informed debate, looking at the innovation process both in terms of its goals and the methods used".

Need for Greater Resources Allocated to Health, Life Sciences and Biology

Figures show that the scope of the field in which France is expected to compete is not compatible with the resources allocated to research and development. Thus, development of eastern and southern Asia will lead to major changes to the global geopolitical and economic map, which will modify the balance of power in the area of research and innovation.

Investment in research and innovation has major long-term effects and any delays are virtually irreversible. Some of the main strengths of French industry today are the result of decisions taken in the 1960s. As regards technologies, France and Europe missed out on the IT revolution in the 1960s and have only partially recovered, due to the telecommunications industry boom. The next two technological revolutions are likely to concern:
- The field of **health and life sciences**, which are linked but do not coincide. Noting that biology in France already lags behind the US, we can ask whether this is irreversible or can it be brought under control?
- **Closer ties between biology and information** and communication technologies, in which Europe runs the risk of being relegated to a tiny role if current trends persist.

In this respect, specific attention should be paid to sectors that are at a crossroads between fields. Examples are hardware, nanotechnologies and certain biotechnologies. If Europe was to lose ground over the next decade, the fallout would still be significant in 2030. In addition, it appears that:
- No European country with the possible exception of the UK, is capable of maintaining an adequate security and defence system on its own.
- In terms of R&D, strong European partnerships are essential for the creation of global centres for excellence.

If Europe and France do not devote enough resources to these areas, economic growth which is already at risk of slowing down will be compromised.

European R&D's Future in a More and More Competitive Environment: 5 Scenarios

The scenarios are designed to enable a systematic review of possible changes in the FRIS over the next 20 years, with the goal of shedding light on a number of key issues. In this way, it will be possible to assess the consequences of a certain number of events and public policy options. Six scenarios were developed:
- **Scenario IA - Defensive Decline** where Europe is struggling to become organized. Public research is losing its relevance due to funding cutbacks. France is forced to abandon part of its current RDI objectives.
- **Scenario IB - Opportunistic Passivity** international economic growth is stronger, leading to a slight increase in the volume of public research focusing on high-potential fields for the future.
- **Scenario II - a Wager on National and Regional Dynamism** in a world marked by conflictual relationships and relatively low levels of growth, the European Research Area is unable to progress due to a lack of agreement between member states. However a relatively

positive pragmatism enables structural changes in public research and the development of RDI in SMEs nationwide.
- **Scenario III - Ambition for France and Europe** in a quite similar context, but with comparatively favourable growth, the European Research, Innovation and Higher Education Area is set up, with major programs including defence-security R&D.
- **Scenario IV - Pragmatism in a Europe of Regions** in a context of a US leadership and relatively strong economic growth, China and India are emerging relatively smoothly so that geopolitical balance is being called into question. A European Research, Higher Education and Innovation Area is set up with major programs, but this excludes defence-security R+D, state reform and decentralisation is accompanied by structural changes in public research. With this scenario there is a risk that Europe will become too fragmented and that this fragmentation at regional level could cancel out expected benefits of the scenario.
- **Scenario V - France a Player in a Powerful Europe** in a multi-polar world of regulations based on the US, China, India, and Europe, with relatively strong levels of growth, an ambitious European Research, Higher Education and Innovation Area is set up, ranging from basic research to major programs and defence-security R&D, the public has greater confidence in innovation, and this derives from more open and transparent debate processes, the reform and decentralisation of the state is accompanied by structural changes to public research, which is organised around regional centres.

Key Political Issues

This foresight exercise underlines new approaches to organisation, finance, marketing, logistics, software development, research and training. In this context according to the expert group, horizontal economic and social policies should ideally include:
- Actions offering compensation for the underprivileged, while avoiding the maintenance of obsolete structures,
- Macroeconomic policies to facilitate sustained economic growth,
- Employment policies aimed at reducing unemployment by increasing labour market flexibility,
- Life-long education and training policies that foster initiative-taking and that increase the adaptability of the workforce.

In addition to these horizontal policies, more selective actions could be taken if there are economic and social externalities, when the market focus is too short-term, when there is a need to compete for subsidies received by foreign competitors, or when there are major imperfections in the functioning of the venture capital market.

Therefore it is now necessary for France to make choices: the country, while continuing to improve the productivity of its R&D system, must reconsider its R&D objectives and/or increase public R&D funding. Without major reform, there is little chance of the Lisbon objective of 3% with 1% public -2% private being achieved over the next 20 years.

The first proposed reform would involve entrusting responsibility for research in the broadest sense of the term to a large and fully-operational ministry. However, this responsibility must not include the management of public research organizations. This ‘Ministry of the Future’ must make strategy the priority and guarantee a long-term focus. Its scope should include the world of businesses and the economy as well as state institutions.

Secondly, France lags significantly behind comparable countries in terms of private sector funding for innovation. The state can only influence its policies through actions to make research an attractive option for business investment France. There are three types of action that need to be considered:
- The extension of research tax credits. These have the advantage of being an automatic incentive applicable to all companies,
- The creation of centres of excellence for research and innovation in the fields that will result in major economic activities,
- At the crossroads between public research and private research lies the key issue of intellectual and industrial property and valuation policies.

Many of the prominent experts interviewed believe that a public R&D policy needs to be set up at the European level. More specifically, the proposals for the financial outlook for 2007-2013 presented in February 2003 by the Commission express a strong desire to promote the competitiveness of businesses and ramp up European research and technological development efforts, including the space and security sectors. European budgets will be granted as contracts for long-term projects. This study has, however, raised a number of problems:
- How to handle the strategic management of European R&D,
- How to prevent the allocation of European contracts from being affected by a bureaucratic and inefficient fragmentation of resources,
- How to increase the flexibility of resources for French public laboratories so that, in terms of total costs, they are able to cope with changes in their income over time.

At last, it is more specifically at the local level that it is important to take actions to develop close relations between public research and the economic environment, notably in the main regional centres. In terms of the actual amount of funding, the regions play an insignificant role at present.

The scenarios show that without a large-scale reform of tax transfers and without initiatives to establish the decision-making bodies required, the role of the regions will remain a secondary one. Nevertheless, because they have access to structural European funds, and are active in the development of the region, they have the potential to be an 'active component' of Operation FutuRIS, notably by contributing to the emergence of powerful centres that bring together higher education, public research, innovative business creation, and industrial research.

Policy Impact

The main report on Operation FutuRIS was published on 5 October 2004. In it the four working groups identified about fifty parameters likely to influence the future of the Research and Innovation System in France. These results are being used in the on-going S&T policy debate in France and provide inputs for the new orientation and programming Law on Research. They have been used as a basis for general debate on the future of research in France. The scenarios are being used as input for the following R&D policy issues:

- The source and structure of funding for public research, how to match resources to objectives within the system, and human resource needs in public research,
- Europe, Regions, Nations and pôles as 'public engines' of innovation, the European dimension of R&D and the role of large programmes,
- R&D and innovation in firms, the structure of financing for private R&D and the attractiveness of territories on the location of R&D.

This exercise served as a collective learning and analysis tool. It supports a policy debate where the research and innovation system is considered as a whole with the complete range of associated objectives. In January 2005, FutuRIS produced a new document that contains 15 proposals for reform of the French System of Research and Innovation.

Sources and References

- 'Opération Futuris', Synthesis Report for a National Debate, ANRT March 2004
- 'Le système français de recherche et d'innovation : Proposition pour une réforme' ANRT février 2005
- 'Avenirs de la recherche et de l'innovation en France - sous la direction de Jaques Lesourne, Alain Bravo, Denis Randet', Les Etudes de la Documentation française n° 5200 (Octobre 2004)

Relevant Links:

http://www.futuris-village.org/index.htm
http://www.anrt.asso.fr/index.jsp

The Chemical Industry in Flanders – Towards 2010

Authors:	Arnold Verbeek of IDEA Consult / arnold.verbeek@ideaconsult.be		
Sponsors:	Flemish Science and Technology Policy Council, FEDICHEM – The Federation of the Flemish and Belgian Chemical Industry		
Type:	A Regional-national foresight process covering various subfields of S&T relevant to the chemical sector, taking account of socio-economic and cultural trends		
Organizer:	Arnold Verbeek, Koenraad Debackere, and Raf Wouters at the R&D Division of INCENTEM at the Catholic University of Leuven in Belgium		
Duration:	2002-2003	Budget: € 35 000	Time Horizon: 2003-2010

Motivation

The chemical sector in Flanders-Belgium is among the largest in Europe and the petrochemical centre around the port of Antwerp is the second largest in the world. This foresight study intends to contribute to maintaining and even strengthening the competitiveness of this sector in the future. The approach was to:

- ***Identify and map future scientific and technological developments in the chemical sector from a socio-economical perspective,***
- ***Offer companies in the chemical sector in particular their R&D managers, a window-of-opportunity through which to gain a long-term perspective on the industry and anticipate their future needs in terms of RTD capacity.***

The Importance of the Chemical Sector

The chemical sector is one of the most important industrial sectors for Flanders and Belgium in terms of both employment and export. On the basis of turnover per inhabitant, Belgium is the absolute leader in the chemicals sector in Europe. The region of Flanders has a long history in the area of chemical production. Already by 1759 there was a well established industry for the production of acid and artificial fertilizers. By 1861 the Solvay-process for the production of soda had received international acclaim. Today Flanders is recognised as hosting one of the most chemical industry concentrations not only in Europe but in the World.

The petrochemical centre around the port of Antwerp is of strategic importance to the Flemish, Belgian and European economy.

Shaping the Future — a Collective Process

Future studies are a recent phenomenon in Flanders. About 6 years ago a first study was carried out in which worldwide foresight exercises on the chemical sector were analyzed and synthesised. Subsequently a foresight methodology tailored to the Flemish environment was developed. Based on this methodology, a number of foresight studies were carried out. This study responds to a strategic ambition of the Flemish Science and Technology Policy Council or STPC to develop a long term strategy for technological innovation in Flanders. This study was intended not only to take account of worldwide trends in related sectors but the Flemish socio-economic context as well.

This study has contributed to the development of strategic priorities as well as the creation of a 'common ground' for future decision making in relation to the sector.

The objectives of the study were to:

- Identify and map possible future scientific and technological developments from a socio-economic perspective.
- Identify and analyse those factors that would facilitate timely anticipation on these developments. Such factors include research capacity, infrastructure and other economic issues such as labour costs.
- Offer companies and policy makers in and around the chemical sector a 'window of opportunity' based on consensus.

This project was divided in two phases:

- An internal analytical phase which aimed to identify

topics and developments of major importance for the future of the chemical sector.
- An external phase, where a refinement and feasibility analysis of the issues identified in phase one was carried out. In this phase consensus-building, communication and awareness creation play an important role.

In phase one a detailed analysis of the available foresight literature was conducted in parallel with 18 face-to-face interviews involving experts from academia, the private sector including major chemicals companies in Flanders as well as NGO's.
The interviews touched upon issues such as:
- Technological and scientific developments and trends,
- Market trends,
- Knowledge needs and knowledge gaps as well as other
- Socio-economic factors of importance.

Based on the vision that 'shaping the future is a collective process', a short e-mail Delphi-questionnaire involving national and international experts was carried out. The developments identified in phase one of the foresight exercise were formulated in over 100 statements and sent out to 33 experts for evaluation on the following dimensions:
- Feasibility and timing,
- Impact on society and on competition,
- Confidence to realise and implement, and the
- Expected role of government.

This last issue related to issues such as support for R&D funding and the development of infrastructure. This process resulted in expert opinions on different aspects of identified future developments.

Essential to this study was the development of a three-dimensional conceptual viewpoint, involving:
- Socio-economic forces around the chemicals industry,
- S&T developments and effects,
- Impact Area or sub-sector affected.

Technical and Societal Changes Affecting the Chemical Industry in Flanders

Chemistry is a science pioneered by Avogadro, Lavoiser and Liebeg more than 200 years ago. Today the field has evolved and chemistry is conducted on the microscopic and even nanoscopic scale of single atoms and molecules. The chemical sector today draws its knowledge from different fields such as biology, physics, agriculture and the sciences. It is a complex sector with many sub-sectors and niches. The products of the sector vary from basic chemical production to specialty chemical production exemplified by the pharmaceutical industry. The main influences on the development of the chemical industry are as follows:

- **Supply side:** The chemical sector is strongly integrated; and about 1/3 of the output of the chemical sectors finds its way back in the form of intermediary supplies. As a result, there is a strong dependency and risk as a result of fluctuations in the availability of crude oil and partnerships are important to deal with this situation.
- **Economic climate:** The demand for chemical products depends to a large extend on industrial production levels in other sectors such as construction, automobile and electronics.
- **Globalisation:** Increasing globalisation has lead to increased competition. In specialty chemicals, we can expect increased competition from upcoming countries like China, Mexico and India.
- **Environment and the regulatory framework**: Increasingly, the chemical sector is stimulated to search for alternative technologies and processes. Regulations and initiatives laid down in EU white and green papers, Kyoto protocol etc. empower this search.
- **Substitution factor:** Technological developments in areas such as biotechnology and new materials enable the substitution of existing chemical components in products and industrial processes.

Technological development increasingly offers an adequate response to upcoming socio-economic demands and expectations. For example the expectation and demands of society in relation to environmental protection can be met to a large extend by developing new production methods and by speeding up existing processes towards a more efficient use of materials and energy.
Opportunities offered by the field of biotechnology seem quite promising. Technological developments can not only address societal issues such as care for the environmental but they can also provide competitive advantage as well.

Promising Fields and Anticipated Developments

1 - Chemical Synthesis with a Focus on Catalysis: In future:
- Catalysts will be customized and put together from single components.
- It will be possible to combine the high selectivity of homogeneous catalysis with the robustness of heterogeneous systems by supporting molecular species on the surface of solids such as zeolites and silica.
- Mesoporous solids - new robust solids with hollow channels the dimensions of which can be controlled in the molecular assembly process will have many uses including vehicle exhaust cleaning.

Chemists will apply natural processes such as these to industrial chemicals and materials to achieve higher efficiency and improved safety.

2 - Bioprocesses and Biotechnology based Materials Technology: In the future:
- Metabolic pathways will be fully understood.
- Low cost raw materials for bioprocesses will be derived from agricultural and forestry wastes and, to an increasing extent, cultivated feedstock.
- Biotech-based processes will enable the manufacture of chemicals with greater energy efficiency and environmental care.

3 - Materials Technology: It will be possible to:
- Design and predict material properties from the molecular through to the macroscopic level relying on easy-to-use computational tools.
- Precisely manipulate materials from the nano- to the macro-scale.
- There will be increased acceptance of methods for disassembly and reuse and widespread use of polymer synthesizing processes that use renewable resources instead of conventional petrochemical processes.
- Surface coatings will change colour with temperature.
- Special polymers are even now being tested for fire-proof cushions and panels in aircraft and cars. The emphasis right now is on applications that improve human safety.

4 - Process Science & Engineering Technology: Process design will be viewed more comprehensively and will focus on the principles of:
- Concurrent engineering,
- Design from first principle,
- Improved energy efficiency,
- Protection of human health, safety, and the environment.

Some precise developments include:
- Zero Net Life-Cycle Waste,
- Intelligent Control Systems,
- Model-based failure and mitigation, and
- Many new commercial processes will use recycled raw materials as feedstock.

5 - Chemical Measurement & Analysis: Non-specialists in the scientific community will be able to use research-grade analytical measurement instruments. Some specific improvements include:
- All critical process chemistry will be measured accurately on-line in a manufacturing environment. Interfaces, particulates, and aerosols will be accurately and precisely characterised.
- Large combinatorial chemicals will be routinely measured and characterized.
- Analysis cycle time will be reduced by a factor 10 of what it was in 1990.
- Crystallography and resonance spectroscopy will be used routinely to determine macromolecular structures.
- Sample preparation will no longer be needed for routine analytical measurements.

6 - Computational Technologies: These will lead to:
- Shortened product-process development cycles.
- Optimised processes to improve energy efficiency, and
- Efficient design of new products and processes.
- Highly reliable atomic modelling will allow companies to rapidly design new materials that address environment, health and safety issues. Process modelling and optimisation will be an integral part of the development and implementation cycle. Coupling process science and engineering with the basic sciences will ensure rapid development, design, and scale up. Design methods will include sampling thousands of variations of chemistries from a library to find candidates for development.

7 - Energy and Feedstock: Global partnerships involving customers, carriers, feedstock suppliers, co-producers, and third party service providers, will structure marketing and distribution operations from a global perspective. The safe and efficient distribution of chemical products will continuously improve generating major benefits for the chemical industry in terms of economic and environmental gains. The responsiveness of chemical companies to the changing requirements of their customers will increase.

The underlying detailed developments (in statements) were presented to a panel of experts for further assessment. This has lead to a detailed insight on how different developments affect internal competition in the sector, society in general and the confidence companies have on their ability to implement.

This insight, together with the information obtained during the face-to-face interviews, has enabled the formulation of a number of precise policy recommendations.

Policy Recommendations and Effects

In the past decade the chemical sector has become one of the most important sectors in the Flemish and indeed the Belgian economy. This foresight exercise has shown that in order to stay competitive the government and industry should take action on a number of challenges that are not only scientific and technological socio-economic as well. These non-technical issues include the reputation of the sector, the impact of globalisation and competition, the cost of energy and the need to protect the environment. Technology foresight studies are a means to identify these challenges and formulate an adequate response. The first findings have been achieved on the basis of a careful and rigours process involving industry and other stakeholders. A series of recommendations have been brought to the attention of the Flemish Government and to the Ministers concerned. Companies from the sector together with the federation FEDICHEM have taken a number of initiatives to implement and further refine these recommendations, for example on the basis of university–industry collaboration on specific R&D topics. R&D managers within companies have had an opportunity to compare the findings of this study with their own in-house priorities. The outcome of this study has acted as an impulse for further investigation and thinking about the future of the sector. The main recommendations are as follows:

- With the support of the government the sector has to work on its **reputation** with the broader public. Public opinion is important in many respects. It includes youth perception of the sector and the interest it holds for building a career.
- The availability of HR is an issue of concern. **Sustainable development** is certainly a horizontal issue cutting across every aspect of the sector.
- There is a need for support in the implementation of regulations especially in the case of SME's.
- The future of the sector depends not only on its economic viability but on the availability of qualified staff. This is a seen as a major threat to the sector.
- It is recommended to develop **pre-competitive**, and where possible **competitive, knowledge platforms** supporting national and international companies in their R&D efforts.

Further Foresight Activities in the Chemical Sector

In relation to each of the above-mentioned fields, a number of recommendations have been made that vary from support and awareness raising actions to promote public-private cooperation and collaborative research, to the funding of specific initiatives. In some cases the government can and should play a role whereas in other cases the sector should act on its own. Structural involvement in the numerous international S&T foresight initiatives is recommended. The STPC in Flanders is currently carrying out a large regional foresight study in order to identify and evaluate S&T developments and as such support the prioritisation process of the respective Ministries.

Such a window-of-opportunity for policy makers, business managers, R&D managers as well as academics shall facilitate and stimulate coordinated actions and efforts. Foresight increasingly acts as an input for strategic decision making. There is scope for follow-up activities to refine the findings of this study on the basis of new foresight studies within small groups involving companies and research institutes.

In this way foresight can provide a vehicle for '*wiring up the national innovation system*'.

Sources and References

http://www.fedichem.be/en/view
Federation of the Belgian Chemical Industry

http://www.vrwb.be
Flemish Science and Technology Policy Council

The Food Industry in Flanders Towards 2010

Authors:	Arnold Verbeek of IDEA Consult / arnold.verbeek@ideaconsult.be		
Sponsors:	The FSTPC - Flemish Science and Technology Policy Council, FEVIA - The Federation of the Flemish and Belgian Food Industry		
Type:	A Regional-national foresight process covering various subfields of S&T relevant to the food sector, taking account of socio-economic and cultural trends		
Organizer:	Arnold Verbeek, Koenraad Debackere, and Raf Wouters at the R&D Division of INCENTEM at the Catholic University of Leuven in Belgium		
Duration:	2002-2003	Budget: € 35 000	Time Horizon: 2003-2010

Motivation

The food sector is one of the most important industrial sectors in Flanders. The aim of this foresight exercise was to identify and map future scientific and technological developments in the food sector from a socio-economical perspective and to identify future needs for industry working in the sector. The outcome of the study directly feeds into the strategic policy making process of the Flemish Government. At company level the aim is to provide managers, R&D managers and researchers with a 'window of opportunity' through which to 'benchmark' their own company strategy.

Shaping the Future A Collective Process

Future studies are a recent phenomenon in Flanders. They were first introduced about six years ago with a large initiative to describe and analyse worldwide trends and developments in foresight, and to develop a foresight methodology tailored to the Flemish environment. This study relates to a strategic ambition of the FSTPC – the Flemish Science and Technology Policy Council to develop a long term strategy for (technological) innovation in Flanders; hereby keeping into account worldwide trends and the Flemish socio-economic context. Strategic prioritization and the creation of a 'common ground' for future decision making should be facilitated.

The objectives of the study were to:
- Identify and map possible future technological developments from a socio-economic and from a consumer perspective that takes account of shifts in consumer preferences and behaviour.
- Identify and analyse those factors that would facilitate timely anticipation on these developments such as research capacity, infrastructure and other economic issues such as labour cost.
- Offer companies and policy makers in and around the food sector a shared 'window of opportunity' based on a consensus model.

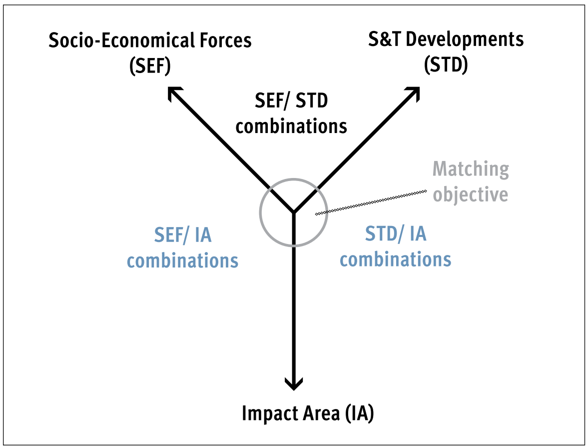
The project was divided in two phases:
- An internal analytical phase that aimed to identify topics and developments of major importance for the future of the food sector.
- An external phase to refine and assess the feasibility of recommendations arising from the first phase. In this phase consensus-building, communication and awareness creation play an important role.

In phase one about 20 face to face interviews were carried out with experts from academia, the private sector and from NGO's. This was done in parallel with a detailed analysis of the available literature. The interviews touched upon issues such as:
- Technological and scientific developments and trends,
- Market trends,
- Knowledge needs and knowledge gaps, and
- Other socio-economic factors.

Based on the developed vision that 'shaping the future is a collective process' we carried out a short e-mail Delphi-survey. This involved a group of 29 experts. More than 100 statements were evaluated by our experts on factors such as:
- Feasibility and timing,
- Impact on society and competition,
- Confidence to realise and implement, and the
- Expected role of government - for example in terms of support for R&D funding or infrastructure development.

This resulted in a detailed insight into the overall feasibility of possible future developments. Essential to this study was the development of a three-dimensional conceptual viewpoint illustrated below and involving:

- Socio-economic forces around the food industry,
- S&T developments and the impact of developments in upstream sectors,
- Impact Area or sub-sector involved.



Impact Factors: The Consumer as a Major Driver...

The food sector employs more than 85 000 people in Flanders and with a turnover of more than €30B per year it is one of the largest sectors in Flanders and Belgium.

It is rather a soft sector in terms of technology due to the fact that to a large extent it tends to adopt and internalize technologies developed in other sectors. It is also highly susceptible to public opinion. The biggest identified challenge is that of maintaining and in some cases re-establishing a relationship of 'trust' with the consumer in terms of the quality of its products.

The trend analysis was carried out on two levels:

- A **meso-macro** level to identify industry-wide drivers, developments and trends,
- A **micro** level of the consumer and changes to consumer preferences and habits.

On the **meso-macro** level the following drivers of change, and accompanying developments were identified:

- Internationalisation: A process whereby food products – ingredients and final products - from all over the world enter the European market.
- Societal Change: For example the increased participation of women in the work-force reduces time available for cooking and new demands have to be met in terms of the nature and availability of pre-cooked foods.
- Agricultural Developments: The classic example is the production of GM crops.
- Political Change: This includes the re-organization of subsidies for food production.
- The Environment: Society now demands environmentally friendly methods of production.
- The Regulatory Framework: The application of law to quality assurance, novel foods, GMO, labelling and other activities relating to the food industry.

'Alienation' of the Consumer and the Role of 'Trust'

Of specific interest is the alienation of the consumer; it seems increasingly problematic for consumers to follow and understand the various developments in and around the food industry. This translates into uncertainty about the safety and the quality of the food products. Consumer trust which is crucial to the future development of the sector is being affected as a consequence of alienation.

On the micro-level, that is the level of the consumer, 10 major trends and developments were identified:

- **Do-It-for-Me foods:** These correspond to an increasing demand for highly personalised food products.
- **Taste and Sophistication**: There is an increasing demand for tastier and more complex food products in line with increasing purchasing power of the consumer.
- **Balanced Nutrition:** Food products should be nutritive, healthy and tasty, all at the same time.
- **Form follows Function:** Food should look good and should be user friendly on every occasion. This includes the provision of personalized portions.
- **Social Character:** Food and food products should stimulate and facilitate social gathering. This puts demands on aspects such as packaging and the time required to cook or to prepare.
- **Children's Segment:** Growing importance of the children's segment appeals on the development of new techniques and approaches.
- **Light and Fresh:** Increasingly food products should look fresh and should be light to consume and digest.
- **De-structured Eating Patterns:** This requires flexibility in food consumption.
- **Personalised Nutrition:** Do-it-yourself health food products enriched with nutritive functions.
- **Clean, Pure and Safe:** Consumers want trustworthy food.

All of these trends influence scientific, technological and even commercial aspects of the food production and distribution cycle.

As a result, new capabilities and expertise are needed in a range of food related areas such as formulation of ingredients, processing and packaging.

Promising fields and Anticipated Developments

Seven promising scientific and technological fields have been identified with respect to the future developments in the sector. The table below illustrates these fields and presents some of the main underlying trends and expected developments.

Ingredients Production and Raw Materials:
- The replacement of natural ingredients by artificial ingredients.
- The development of ingredients to compensate for the loss of organoleptic characteristics in 'healthier' foods.

Food Processing:
- Up to 50% of the thermal processes used in food processing will be replaced by non-thermal processes such as use of high pressure processing techniques.
- New processes will be based on scientific insight and computer based models instead of laboratory research.

Packaging:
- Intelligent packaging.
- Bio-degradable packaging.
- Taste preserving packaging.
- Functional packaging.

Biotechnology as an enabling technology for the food sector:
- Intensive use of biotechnology for the production of ingredients.
- The use of herbicide resistant crops.
- The use of GMO techniques to create new species.
- Functional and nutraceutical food products.

Food Science and Engineering Technology:
- Unraveling the relationship between the structure of food ingredients and their properties.
- A full understanding of the effect of existing food technologies on human health.

Measurement and analysis:
- Online process monitoring.
- The introduction of biosensors.
- Personified testing and analysis of food quality.

Water purification and supply:
- The introduction and application of new purification techniques such as membrane and plasma technologies aimed at generating zero waste.

Recommendations: Increasing Public Acceptance of Modern Food Production Methods

The food sector is one of the most important economic sectors in Flanders and in Belgium. This study has identified the most important challenges faced by the food sector; not only from a technological or scientific perspective but also from a socio-economical perspective.

One of the most important conclusions is that this first sectoral foresight exercise in Flanders has convinced experts from policy, industry and academia about the advantage of using foresight to create:
- A common ground for policy making,
- A shared view of future developments, and
- A window of opportunity for companies and their R&D managers.

The recommendations have been brought to the attention of the Flemish Government and in particular to the attention of the Ministers concerned, thereby influencing policy decisions in relation to the food sector. Several of the recommendations from this exercise have already been implemented or are currently in the process of being implemented. In particular 'Flanders Food' has been created as an innovation platform for the food industry. Companies in the sector along with the sectoral federation have taken several initiatives to implement and further refine the recommendations. This study has stimulated further investigation and thinking about the future of the sector. Let us review the main recommendations.

Based on the expert opinion on scientific and technological developments that could be expected to have an impact on the sector it was judged that the following issues would be critical for the future development of the food industry in Flanders:
- Cross-fertilization with other sector and S&T fields,
- Knowledge and expertise sharing both within the sector and with related sectors.

These results have provided part of the motivation to create what is known today as 'Flanders' FOOD' - the **innovation platform** for the Flemish Food Industry. This platform addresses the need to support small and medium sized industry in their search for innovation in the sector. SMEs account for about 90% of the total firm population in the sector. They need support if they are to adequately address the challenges faced by the sector, challenges that are socio-economic, scientific and technological.

On the socio-economical level the **reputation** of the food industry with the perspective of the broader public is crucial for growth in the sector. Consumers should have available objective and trustworthy information about food, safety, and health. Adequate safety systems need to be put in place. The need to address this will become more urgent with the creation of a European Food Safety Agency.

The **alienation** of the consumer is a second major challenge that all companies face. Consumers and the NGO's that represent them refer to a growing knowledge gap between the industry and the consumer. Experts judge this to be of great importance for progress in the sector. They caution that this will be difficult if not impossible to remediate.

Knowledge from disciplines such as psychology, the communication sciences, sociology and anthropology, will need to be used by the food sector when approaching the consumer and when addressing consumer related issues such as alienation and consumer trust.

Another challenge is that of **sustainable development.** Food related processes must now be redesigned with a view to achieving 'zero-waste'.

The availability of suitable **human capital** is as important as any other challenge faced by the food sector. The decreasing numbers of students in the food sciences worries those involved in the sector. The government together with industry now needs to take steps to promote the sector as an attractive and challenging career option. It may be necessary to provide incentives such as support through scholarships to encourage young people to pursue degrees in areas of importance for the sector.

This study together with other work undertaken by the R&D Division of INCENTIM at the Catholic University of Leuven has stimulated the institutionalisation of foresight studies within the S&T policy system in Flanders.

A larger regional foresight study is currently being carried out in order to further help prioritise policy decisions in the Flanders region.

Sources and References

Federation of the Flemish and Belgian Food Industry
http://www.fevia.be

Flemish Science and Technology Policy Council
http://www.vrwb.be

AGORA 2020 – Transport, Housing, Urbanism and Risk

Authors:	Isabelle Chatrie/ email address: isa@ll-a.fr Julie Rachidy/ email address: julie@ll-a.fr
Sponsors:	DRAST a scientific agency linked to the 'Department of Transport, Housing and Construction' of the French 'Ministry of Infrastructure, Transport, Housing, Tourism and the Sea'
Type:	National foresight exercise
Organizer:	DRAST with the cooperation of the French futuRIS program and at European level with the cooperation of the ERA-NET initiative entitled 'ForSociety'
Duration:	2003-2005 Budget: Unknown Time Horizon: 2020

Purpose

Agora 2020 is a foresight exercise on the demand of research on transport, mobility, housing, construction, urbanism and risks, launched in spring 2003 by the DRAST -Directorate of Research and Scientific and Technical Affairs of the Ministry of Infrastructure, a scientific agency linked to the department of transport, housing and building. The project's aim is to build up a clear vision of middle and long term issues in the field of transport, housing, town planning to establish priorities and incentives for the next research programs in France.

Looking for Answers to Key Societal Questions

Today it is increasingly expected that research can provide answers to concrete societal questions. It is also expected that research can help enterprise, local actors, consumers, citizens and society anticipate their future needs. This expectation lies behind the recent proliferation of foresight exercises across Europe and the world. This recent rise of foresight is a response to a need for planners and other stakeholders to understand evolving social needs and build common visions based on an appreciation of emerging issues.

Perhaps more than in the case of any other ministry, research led by the Ministry for Infrastructure on Transport, the City, Housing and other accommodation, Infrastructure, Regional Development and Earth Observation is dedicated to the satisfaction of common needs.

So far however this work has not been embedded in a large consultation process equivalent to those conducted in other fields.

AGORA 2020 was launched by the DRAST - Directorate of Research and Scientific and Technical Affairs of the Ministry of Infrastructure - in spring 2003. This was done in cooperation with the French futuRIS program and with an ERA-NET initiative entitled 'ForSociety'. It aims to assess the future needs of society that fall within the remit of the Ministry for Infrastructure.

Its objectives are:

- To develop a common vision of medium as well as long-term societal issues, and
- Formulate the key questions that need to be asked right now,
- Understand expectations for the future of the main categories of actors, as an input for the,
- Development of strategic priorities for actions to be taken right now.

The overall approach was to involve researchers from relevant research centers, politicians and civil society in a series of seminars, workshops and surveys.

The exercise put a lot of emphasis on gathering background information and forecasts that would provide the basis for a rigorous and broad consultation process.

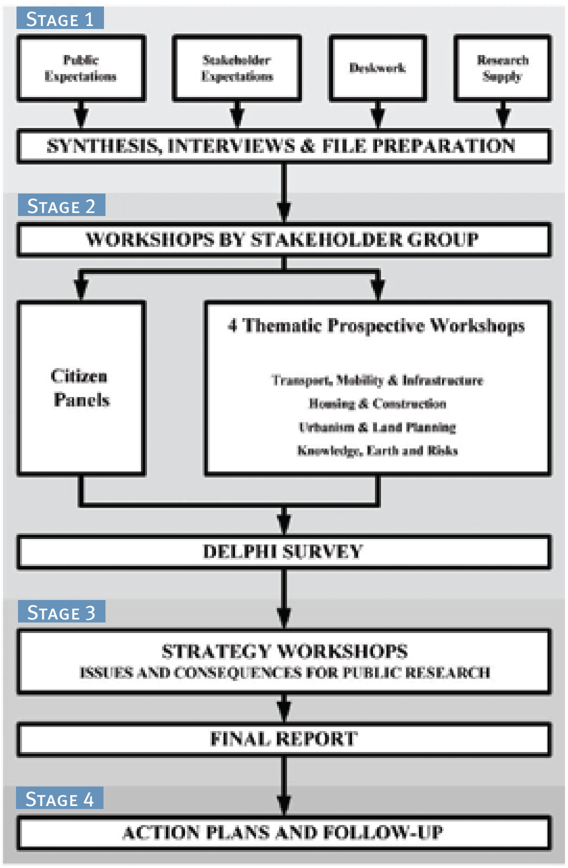
From Expectation to Innovation

The AGORA 2020 exercise was composed of four stages as indicated in the diagram on the right:

- The first stage was dedicated to the identification of the expectations of various categories of actors and their perceptions of major issues related to future of local and national infrastructure. These actors included companies and associations, experts from public administrations and local authorities as well as researchers from universities and national research institutes.

- In the second stage foresight material was provided to participants and discussed in order to pinpoint some key orientations and visions relating to selected questions. These orientations lead to specific requests for further information and analysis from the innovation and research communities. Expert workshops, fora and a DELPHI survey were conducted.
- The third stage aimed at translating the survey results into proposals and recommendations for more precise innovation and research projects.
- The fourth and final stage was dedicated to the uptake and exploitation of the results of the exercise and to the further elaboration of ideas to develop research and innovation strategies that had started to emerge from the stage 3.

AGORA 2020 is supervised by a Steering Committee chaired by Pierre Papon - General Director of the CNRS or Centre National de la Recherche Scientifique.
In addition to this an Orientation Committee and a forum composed of representatives of all the organisations involved in the exercise assisted the Steering Committee in the management and implementation of Agora 2020.



Territorial Issues at the Heart of AGORA 2020

The four stage process of Agora 2020 led to the identification of a number of priority areas for action. Although the final report and conclusion should be available in late 2005, some observations can already be drawn from the programme:

Identification of the Main Socio-economic Issues

Transport and Mobility

The expected increase in **price of oil and environmental regulation** raises questions such as:

- How to enhance the development of fuel cells?
- How to build a strategy in order to diminish numbers of cars on roads with the lowest possible social impact?
- How to change the behaviour of drivers?

The difficulty of building **new infrastructures** on congested axes due to NIMBYism as well as financial and environmental constraints raises the question of how to improve public transport without tariff increases?

Globalisation contributes to strong evolutions in the functional and territorial organisation of productive activities and associated commercial and migratory flows. Its impact on transport and infrastructures choices is crucial. This raises questions such as:

- What are the forecasts about Asian development and tourism flows?

Drivers such as **new technologies, demographics** and the **desire for mobility** raise questions related to:

- Traffic regulation and transport security
- The mobility behaviour of elderly persons and their risk of exclusion,
- Cities and Territorial Planning Issues.

Questions arising here fall under the following main headings:

- **Demographic Change and its Consequences:** The living conditions of elderly persons, their needs in terms of specific housing and access to medical infrastructure, as well as the risk of geographic segregation between 'young areas' and 'old areas'.
- **Social Exclusion and Precariousness:** This includes issues related to care for the homeless, those living in ghettos and related risk to the community.
- **Sustainable Land-Planning and Urban Development:** How to limit or manage the extension of peri-urban areas?
- **Multileveled Governance:** How to develop a country in a homogeneous fashion coping with territorial competition and heliotropism?

Housing and Construction

It is important to say that France currently faces significant problems with regard to housing due to an insufficient number of council houses. This situation has fuelled housing speculation as demand for housing is greater than the supply. Issues for the future include:

- **Energy Saving and Cost Reduction:** The development of new insulation materials, renewable energies for housing and low consumption equipments.
- **Housing Sector:** Market assessment and the problem of housing speculation.

Earth Observation and Risk Management

Issues for future research include:

- The development of tools and models for observation.
- Networking and data standards.

Trans-European Issues

Considering the international environment, five main trends or trend breaks were identified:

- The decline of Europe and the emergence of Asia as the centre of the world economy,
- A return to protectionism and local consumption,
- The impact of terrorism and its spill over effects,
- The construction of a 'Wider Neighbourhood' for Europe taking in countries from the Mediterranean Sea to the Ukraine.

Beyond these encompassing issues, inhabitants and members of non-governmental associations expressed structuring ideas about technological trends whereas most of institutional actors followed the 'official point of view'. A great number of trends and trend-breaks were identified and these can be classed into three groups.

Technological Trend Breaks

- The design and commercial development of clean vehicles radically different from those already available.
- The impact of the Galileo system on technical applications and on current life.
- The development of intelligent systems that could alter human behaviour such as speed limit and guidance systems for cars.
- New materials such as biomaterials and nanotechnologies applied to construction and housing.
- New concepts in urbanism and the emergence of submerged and off-shore cities that use domes to protect against sunlight.
- Eco-buildings and ecological cities development.

Territorial Trend Breaks

- Concentration and polarisation of economic activity.
- Urban exodus and the repopulation of rural areas.
- The decline of the suburbs and outskirts of major cities as well as major crisis in these areas.
- Restrictions or limitations on the use of private cars.
- The expansion of teleworking practices.
- The importance of urban regeneration and social mix policies.

Environmental Trend Breaks

- Acceleration of climate changes, multiplication of natural catastrophes,
- Depletion of oil resources (for geological and geopolitical reasons),
- New wave of health risks and diseases.

Change Can Provide Opportunity

All throughout the AGORA 2020 exercise it appeared that there were important differences in perception about the definition of trend breaks. For example key messages drawn from the two first phases relate to highly contrasted, sometimes opposed perceptions of the world and the modern society.

Opinions diverged for example on the future of immigration, on the place for elder people, on values about mobility and on the use of the precaution principle.

Trends in values however were mentioned by a majority of people. These included the right to have access to housing and transport or the development of a communitarian society. Trend breaks on these issues would signal a dramatic change in thinking by French citizens about society. Scientists and other experts consider these issues as sectoral perturbations or asymmetries, whereas other actors see them as opportunities that provide scope for action. Residents of houses for instance, have experienced trends or trend-breaks on issues that are already occurring in their immediate environment. Therefore, their perception of trends and gaps, in relation with environmental, territorial planning or housing issues are seen as opportunities to improve their living conditions.

The Results of AGORA 2020 in the Field of Transport and Environmental Education

Issues considered as priorities illustrate an emerging shift from a traditional perception of dynamics towards a more encompassing approach that mixes variation due to technological and societal forces for change.

Themes are now more closely related to spatial and socio-economical issues rather than to purely technological ones.

The output of the AGORA 2020 exercise is an input to help decision-makers. As the scope of study of this exercise is very wide, policy inputs are mostly emerging issues that should be taken into consideration when drafting new policy guidelines. For example AGORA 2020 results were taken in account for the elaboration of guidance on 'financing infrastructures at the horizon 2020'. The French government has also used the results of the project in discussion about the objectives of the European Commission Seventh Framework Programme for Research and Development.

It is interesting to note that this exercise is followed closely by planners and policy experts in other countries in European such as Finland or Germany.

The AGORA methodology has been used to evaluate qualitative and quantitative future challenges in the area of environmental education and to establish criteria and indicators for evaluating and developing this domain.

Sources and References

References

The 'AGORA 2020' mid-term synthesis report, published by the CPVS – Centre for Foresight and Scientific Monitoring, and DRAST in December 2004: 40 pages and annexes.

'Urban research: What social demand? in 'Crossed perceptions of habitants, local authorities and experts in future urban issues' by the CPVS. November 2004. 10 pages.

Reports and prospective cases drawn from the following specific workshops and published by the CPVS:

- 'Earth Observation and Risk Management' in May and October 2004
- 'Transport and Mobility' in May and October 2004
- 'Housing and Building' in May and October 2004
- 'Cities and Territorial Planning Issues' in May 2004
- 'Administration' in October 2003
- 'Local Authorities' in October 2003
- 'Associations' in October 2003
- 'Enterprise' in October 2003

Synthesis of prospective workshops' outputs, CPVS, December 2003.

Report on first and second Orientation Committee meetings published by the CPVS in June and December 2003.

FORETECH – Bulgarian Technology and Innovation Foresight 2015

Authors:	Tonia Damvakeraki of Atlantis Consulting S.A/damvakeraki@atlantisresearch.gr		
Sponsors:	The Bulgarian Ministry of Education and Science The Bulgarian Ministry of Transport and Communications The European Commission – STRATA Programme The German GTZ Office in Bulgaria		
Type:	This national foresight exercise consists of a series of two sectoral pilots in domains that are considered to be of great importance for the future of the Bulgarian economy: Biotechnology and e-Government		
Organizer:	Zoya Damianova from the ARC Fund of Bulgaria/ zoya.damianova@online.bg The Hungarian Technology Foresight Programme - National Committee for Technological Development Technology Centre AS of the Czech republic The Foundation for Research and Technology - Greece The School of Slavonic and East European Studies in London PREST at the University of Manchester		
Duration:	2003-2004	Budget: € 40 000	Time Horizon: 2015

Purpose

This first-ever foresight initiative in Bulgaria was developed for the purpose of introducing the use of foresight as a tool for policy development at national, regional and sectoral level. The aim was to adapt foresight techniques and methodological frameworks to the Bulgarian environment. This was achieved by implementing two foresight pilots in the fields of:

- ***e-Government, as well as***
- ***Agriculture & Biotechnology.***

Starting Up a Foresight Initiative

The overall rationale for the project was to introduce foresight and begin the process of embedding it as a routine part of the policy development process in Bulgaria. To achieve this two pilot foresight exercises were undertaken, one in the area of Agriculture & Biotechnology, the other in the area of e-Government.

In the case of Agriculture & Biotechnology the key priority of the government was the adoption of a national integrated strategy for the sustainable development of agriculture that is at once compliant with Bulgaria's specific and unique physical features and with the European Union Common Agricultural Policy.

New production methods and new investment policies are needed to make Bulgarian agricultural products more competitive. There is crucial need to enhance and facilitate the development of national capacities for the assessment and management of current and future developments in biotechnology that can help Bulgarian producers to achieve this goal.

The development of expert human resources in biotechnology and capacity building for policy development in this area is a priority. The implementation of a foresight exercise in this field was intended to provide useful policy options to support economic activities that will rely on the application of biotechnology.

In the case of e-Government, Bulgarian policy makers have already designed a programme and strategy for this area. The purpose of a foresight exercise in this domain is to help stretch planning horizons beyond that considered in the existing plans.

Raising Awareness and Creating New Policy Options

The overall objectives behind the initiation of two pilot foresight exercises in Bulgaria were to:

- Inform policy makers of possible future developments in each domain.
- Provide guidelines and recommendations that could be used in devising innovation policies for related sectors.
- Encourage long-term strategic thinking among all stakeholders and reach public consensus on the future course of development.

- Develop and strengthen networks and cooperation among various actors such as government agencies, private sector companies, universities and research centres.
- Mobilize the forces of those capable of action in these domains.

Moving Forward with a Mixture of Methods

The methodology for the foresight pilots was initially developed by the project team at the ARC Fund. This was clarified and evolved on the basis of consultation with knowledgeable consortium partners from the UK, Greece, Hungary and the Czech Republic.

Foresight not only employs specific tools and approaches to thinking about the future such as:
- Scenario planning, and
- Delphi surveys.

It requires the ability to:
- Scope,
- Build Coalitions,
- Organise, manage and implement.

In the Bulgarian case the two pilots followed the same methodology and applied the following specific tools:
- SWOT analysis,
- STEEPV analysis based on a consideration of drivers of change that are Social, Technological, Economic, Ecological, Political, Value based in nature,
- Stakeholder mapping to understand interest groups,
- Scenario Writing, and
- The elaboration of recommendations for actions that could help to achieve desired scenarios or avoid undesirable future developments.

An International Capacity Building Workshop was held in June 2003, at the very beginning of the foresight exercise. It was targeted to provide basic insight on the selected set of foresight tools.

The main goal of this workshop was to clarify the foresight methods by putting them in a concrete context: Experts gave account of their experience designing and implementing exercises in:
- Ireland,
- Hungary,
- The Czech Republic, and
- Venezuela.

The workshop also contained tailor-made sessions that focused on the use of tools:
- The STEEPV framework for eliciting driving forces,
- SWOT analysis,
- Scenario writing, and
- Prioritisation.

In this workshop theoretical sessions were followed by practical exercises to put the knowledge acquired into practice and to balance the abstract impressions of the panellists facing foresight activities for the first time.

The experience of experts involved in foresight exercises in countries such as Hungary and the Czech Republic focused on the foresight process, the methods used and the lessons learned. This kind of mutual learning among peers is of considerable value to those starting out to design and implement foresight for the first time.

Expert panels were the mainstay of the pilot studies. Panel chairs and secretaries proved important in maintaining panel momentum. Each panel consisted of around 15 persons. The e-Government pilot engaged another 100 persons through workshops and a web-based forum. The Agriculture & Biotechnology panel engaged around 40 persons in this way.

Panels met fortnightly over a 6-7 months period, with workshops and online discussions interspersed between these.

The ARC Fund was the project manager, and with occasional help of foreign experts, facilitated the use of various methods.

In the case of the e-Government pilot, a steering group was formed representing the relevant ministries and other stakeholder groups. Its role was to advise and monitor the foresight pilot and to ensure its continuing political and community support.

Finally, a wider pool of experts was involved to disseminate and validate results emerging from the exercise.

Social Trends and Impacts

E-services Central to e-Government Policy

During workshop discussions the e-Government stakeholders expressed a common view that the foresight exercise should focus on the following priority topics:
- The development of e-Government services,
- The development of e-Government enabling technologies,
- Financial aspects of e-Government implementation,
- Education, vocational training and human resource development for e-Government,
- Legal aspects of implementation and development of e-Democracy,
- Development of the channels for provision of e-Services,
- And the need of a differentiated approach for delivering eServices to the targeted users.

During the sixth working meeting of the foresight panel, the e-Government experts decided to put the focus on eServices considered as a process, being a central component of e-Government. The decision was based on the analysed information of the STEEPV and SWOT analysis of e-Government carried out during the previous working meetings of the panel. A working definition of the eServices being a focus of the foresight exercise was elaborated and the framework for the future scenarios was set.

Picking Buffalos and Wine

The 'agro-food' sector is the most important indigenous industry for Bulgaria and as the country has accepted biotechnology as a core technology of the 21st century with enormous potential for benefits, the biotech agro-food sector was chosen as a target for the national foresight exercise. The foresight project is a pilot for Bulgaria and was initially decided to be used to harness the whole production chain. Purpose was to cover areas from the food and drinks industries as well as plant growing and livestock breeding but the focus was finally streamlined only on two pilots in the agricultural area:

The Wine and Vine Industry
Bulgaria is interested in further improving the wine production in the country. Biotechnology is considered as a helpful means for the promotion of the agricultural cultivations in the future and possibly for wine.
Ecological Buffalo Breeding
Ecological buffalo breeding means the traditional breeding of cattle, on farms (not in breeding houses), where they will only be fed natural foods (grass, crops, etc.) and not any processed foods. As much as this exercise is concerned, buffalo breeding is not connected to biotechnology.

Foresight and Policy Reaction and Key Policy Recommendations

The recommendations evolved from scenarios elaborated on the basis of a normative approach. In this approach scenario writing focuses on the possible sequence of events that could lead to a desired future and the key actions that needed to be taken now in order to ensure the occurrence of that future course of development.

e-Government Improving Quality of Life & Performance of the Economy

The interim progress report of the ForeTech project was based on the country review framework, and stressed the importance of the information society and the application of information society technologies to the economy.

During the transition towards the information society, it is very important that public information and services should become widely available to citizens through electronic means.

e-Government services are of major importance for the life of citizens and for the performance of the economy. Bearing in mind that e-Government is a combination of information and communication technologies accompanied by organisational changes and new skill development, e-Government experts from the foresight panel proposed the following set of recommendations to national government:

- The national government should set clear policy goals for e-Government. They should provide roadmaps and create a continual political focus to ensure that identified strategic goals continue to be addressed and continue to feature high on the political agenda.
- e-Government policy should be adaptable and demonstrate long-term commitment. It should allow risk taking and pursue of long-term objectives. Rather than adopting a centralised approach it should play a co-ordinating role.
- It is necessary to establish a responsive legal framework which takes into account of the challenges posed by internet-based information and communication environments.
- A clear vision is needed for ICT development in the public sector, backed up by a strategy for development and deployment.

The Creation of International Networks in the area of Agriculture and Biotechnology

Thanks to the successful implementation of the foresight initiative, foresight is now seen by biotech stakeholders as an effective policy-making tool and as an efficient instrument for consensus building.

By sharing a common vision of the future of wine production and buffalo breeding, the stakeholders actually influence the development towards a foreseen desirable future. Their knowledge of the results achieved makes them stronger players as they striving to have an impact on policies created by decision makers in relevant domains.

This exercise created a common platform for future-oriented thinking among all stakeholder groups. It led to the creation of new networks and partnerships. It even laid the ground for creating new clusters in the field that involve:

- Bulgarian and German Associations of buffalo breeders,
- Bulgarian veterinarian and research institutes,
- Local buffalo breeders, as well as
- Meat and milk processors.

The exercise drew the attention of the Ministry of Agriculture and Forestry to the strengths and perspectives of the buffalo-breeding sector.

Policy Reaction to Foresight Recommendations

The recommendations that emerged from the exercise provided a clear input to the development of an action plan for e-Government strategy implementation. The use of foresight methods has now been included in the general framework for the development of e-Government policy in Bulgaria. As a result of foresight related capacity building among representatives of the state administration, there is now a broader consensual basis for the development of e-Government services.

The Institute of Public Administration and European Integration, responsible for the training of state employees, has scheduled a series of executive training seminars on foresight as part of its e-Government training programme.

Sources and References

http://foretech.online.bg/confbg_2.php

Futur Radar 2030 Demographic Changes, Challenges and Opportunities for the Rhineland-Palatinate

Authors:	Heinz Kolz/ Heinz.Kolz@zirp.de Christoph M. Hadnagy/ mail@zirp.de		
Sponsors:	ZIRP - Futur Initiative of the Rhineland-Palatinate/ www.zirp.de		
Type:	Regional foresight project		
Organizer:	ZIRP - Zukunftsinitiative Rheinland-Pfalz (Futur Initiative Rhineland-Palatinate)		
Duration:	2002-2005	Budget: N.A.	Time Horizon: 2030

Responding to Demographic Change

The population structure of the German federal state of Rhineland-Pfalz (The Rhineland-Palatinate) in South-West Germany will change considerably in the coming decades. This will have impact on every sphere of private and public life. Taking account of projections for population growth in the region Futur Radar 2030 (Zukunftsradar 2030) took a closer look at these developments and the impact they could have on citizens in the region. The goal was to sensitize the public and decision-makers to this and emerging related issue and to make proposals for various actors as to how they might handle the expected change.

Long-Term Issues on Agenda

Discussion on the impact of demographic change has become very popular recently. Until 2002 however the issue was rarely been covered in the press or in public debates. Although the facts have been known for decades, political actors had not yet put the impact of demographic change on the agenda. ZIRP considered the subject of demographic change to be one of the most important issues determining the economic, social, and political development of the region. ZIRP therefore initiated Futur Radar 2030. From the very start, use of the relatively new 'foresight' approach was encouraged by the federal government and by the citizens of Rheinland-Pfalz.

The 'driver' of the project was the demographic change. The State Office of Statistics forecasts an overall population drop and a distinct shift in age structure for Rheinland-Pfalz. Due to prevailing low birth-rates and rising life-expectancy the number of elderly people is expected to grow while the younger generation decreases in size.

The project was divided into four main themes identified in expert workshops as being decisive and influential for the future of the region. Futur Radar 2030 therefore focused on the challenge of demographic change and its effect on:

- Communal affairs,
- Industry and labour,
- Cooperation of the generations,
- Market opportunities.

A Participatory Approach

Futur Radar 2030 adopted a dynamic and open process with several consecutive goals:

- It should initiate a far-reaching discussion of the problem in order to sensitize the public.
- The participants should spread their knowledge on the issue throughout the region and act as multipliers. A participative foresight approach based on workshops and an orientation towards the broader public was selected as the appropriate modus operandi.
- Stimulate positive thinking by the public about demographic change. It was considered vital to identify ways in which changes in population structure could imply favourable effects on the development of the country.
- The results were to be communicated extensively throughout the country.

Foresight Fitting the Needs of the Region

In many respects Futur Radar 2030 is different from other foresight projects in Europe. In co-operation with Dr. Kerstin Cuhls of Fraunhofer Institute for Systems and Innovation

Research (ISI) in Karlsruhe, the method was customised to meet the needs of ZIRP. Futur Radar 2030 is clarified by a clear definition of the object of investigation, and a regional concentration on the federal state of Rheinland-Pfalz. The detailed themes that future teams would work on were fixed by a panel of experts. In this way the long process of detecting the important issues was accelerated and simplified. Each of the four main themes (see previous page) was handled in a similar way:

- Key topics were selected by experts.
- Future Teams of about twelve members each, all with different regional and professional backgrounds were established for each issue.
- In their first two meetings the groups brainstormed, clustered their ideas and topics, and worked on mini scenarios.
- The scenarios were written up and provided the basis for a written questionnaire which was sent to more than 300 experts. These experts were asked to estimate the likelihood of the scenarios happening.
- The scenarios were adapted accordingly.
- The outcome of Futur Radar 2030 was a list of more than four hundred recommended actions for different spheres of action.
- These were summarised into a series of guiding principles or Leitthesen. They do not follow the thematic structure of the group sessions. Instead they combine the many ideas in visionary yet realistic statements.
- Eventually these principles and a PowerPoint presentation about the whole process provided the basis for public presentation of the project outcomes.

Involving the Public

Publicity is an important factor for a successful project. The involvement of as many institutions and individuals as possible is of great importance for the development of a broad dialogue involving the whole society of Rheinland-Pfalz. Public relations activities and the presentation of results rested upon four main pillars:

- **Panel discussions** at regional and national level served as a means to sensitise and motivate local authorities and decision makers.
- **Regular participation** in congresses and symposia helped to find new experts and representatives of target groups for the project.
- **Publications and press releases** about the results were used to reach a broad public.
- A **website** (www.zukunftsradar2030.de) provided a platform for discussion and exchange between the participants. It also provided a substantial source of information concerning every field of demographic change. The site now includes one of the largest collections of commented web-links as well as a list of experts.

Since May 2005, the project work of the experts and Future Teams had been completed. By midyear 2006, the public relation activities are planned to be finished. The project has reached its goal when a broad and continuous discussion on the issue of demographic change is implemented in the public of Rheinland-Pfalz.

The Consequence of Change

The main issue - demographic change - can be seen as a basic challenge for any area of political, social and economic life. Its effects are manifold and only to a certain extent foreseeable. Demographic change implies several major challenges:

- Constant low birth rates lead to a decreasing number of young people in society. This leads not only to a declining population but in the long-run to a shortage of young specialists mainly in technical professions. Generally this has implications for the educational system as well as on family policy.
- The lack of junior employees will lead to a rise in the average age of the work force. Companies have to deal with senior personnel. This causes a fear of a declining capacity for innovation in enterprise.
- As the estimated life expectancy rises the number of elderly people in society increases. This has consequences for the welfare system. In particular it has consequences for the pension system. More and more senior citizens rely on the contributions of fewer employees and previous 'inter-generational contracts' loose their validity.
- The changing proportion of old and young people in society harbours potential for social conflict. It is possible that younger generations will not feel adequately represented in the political realm, whereas a growing number of senior citizens may feel rejected by a youth-centred consumer strategy in advertisement and production.
- Demographic change will differ from region to region. While the urban centres and their greater surroundings will keep on growing in the upcoming decades, rural areas with a poor infrastructure will face serious loss of population. This could lead to challenges in ensuring adequate supplies of goods and services in these regions.
- Fewer taxpayers in regions with declining working populations will put pressure on communal budgets and the maintenance of cultural, recreational infrastructure and other services will challenge local authorities.
- Migration is an important demographic factor. Although it cannot reverse changes in population structure, it may help to slow down such trends. When migration is used as an instrument for managing population change, strategies for integration would need to be improved.

Chances and Opportunities

Demographic changes present not only challenges but opportunities too. Some of these opportunities are:

- New markets for specialised products and services aimed at seniors are opened up by the increasing number of elderly people in society.
- The quality of educational systems could benefit from the lower number of schoolchildren.
- Communal administrations could benefit from technological progress and increase their efficiency.
- Due to the shortage of a young work force, personnel-managers will have to develop new strategies to conserve the operating experience of their senior employees.

Rhineland-Pfalz - Fit for the Future

The expert groups in Futur Radar 2030 proposed strategies intended to prepare Rheinland-Pfalz for these expected developments, and for mastering the challenges of demographic change. The participants generated a package of recommended actions for various professional groups and provided an instrument to make the region 'fit for the future'. Not all of these measures however should be seen as universally applicable principles they still require adaptation to local conditions.

Communal Affairs - a Modern Service Provider

Futur Radar 2030 advocates the continuous inclusion of model calculations on the population development into any kind of municipal planning. This is one of the most important tasks for communal administrations. Local authorities should also increase the efficiency of their structures. In order to save costs, several promising instruments were identified:

- The administration as a whole should be transformed into a modern service provider and bureaucratic regulations should be reduced.
- Incentives should be used to entice companies into playing a more active role in the community. This will increase the companies' attachment to the region and could be a key for corporate success.
- The voluntary actions of citizens should become a central means for the inexpensive maintenance of communal services.

In order to raise birth rates effectively and thereby lower the effects of demographic change, the legislator and likewise the communal authorities should take measures to improve family-friendly structures.

Maintaining a Workforce of Senior Employees

An important task for the future is to keep up the productivity of the economy with fewer and older employees. The conservation and use of the accumulated know-how of the work-force, especially of elder workers is one of the major challenges for companies. Trainee and mentoring programs could be initiated so as to pass on hard-earned knowledge to the next generation of employees.

Family-friendliness will be one of the key issues for the future. The number of female specialists and executives in higher positions must be increased. Work-life-balance must therefore be improved. Politics and the economy must find appropriate actions leading to better compatibility between family-life and work. They need to provide a framework in which women will find the same working conditions as men, in which flexible employment is encouraged, and in which the productivity of elder employees will be preserved by means of workplace design and improved personnel planning.

The whole world of employment will face major challenges due to demographic change, globalisation and technological progress. It is thereby inevitable that the whole economy of Rheinland-Pfalz should embark on a strategy of technical advance and productivity improvement in order to turn the country into a high-tech centre. This will require reasonable steps in many fields of action:

- The education system must be adapted to the new requirements. The promotion of specific skills and talents of the individual should drive the educational agenda.
- Local business development and regional policy should put their focus on creating high tech jobs. At the same time professional training should be organised to provide appropriate qualifications.
- The working people of the region must realise that they are to a great extent self-dependent in their career planning. Individual initiative is needed for success. On the other hand employers will need to offer employees further training programs on a regular basis.
- Payment should be based at least to some extent on individual skills and personal performance. As criteria for remuneration, age and seniority should play a subordinate role.

Cooperation among the Generations

Mutual respect for the needs of each generation is the key for a harmonious and healthy community. Above all the family as an institution needs to be encouraged and supported. The position of the family in society needs to be strengthened through political and social measures. The place and reputation of children in our community must be improved through measures taken by decision-makers in politics, economy, society, and culture. This includes improvement in child care facilities and the promotion of better work-life-balance. The general framework must be constructed by the federal state and the economy, but local decision-makers have to design it according to the needs of the region.

Senior citizens on the other hand have to be enabled to choose their individual life-style according to their abilities and interests. The preservation of mental and physical ability should be supported through access to dedicated services. The elderly will become more active and the availability of special age-based spare-time activities should be extended and improved.

Local authorities have to consider the needs of all generations into their planning. The citizens on their part contribute to communal life by volunteerism. Well directed projects might contribute to a better balance between the generations.

New public and private buildings should facilitate and create opportunities for inter-generational contact. The main intention is to improve relations between the generations. Therefore, modular, flexible and obstacle free methods of construction are required.

Market Opportunities

The change in population structure opens a remarkable job potential for specialists as well as in the low wage sector. An innovation friendly climate, ongoing deregulation and an open-minded estimation of consequences of the technological progress are important preconditions for seizing these opportunities. The greatest possibilities for the regional markets can be found in three areas:

Technology and Innovative Services: The rising demand for appropriate products and services for senior citizens opens up new markets for the future. Communication between the producer and the consumer is very important to meet the needs of the target groups. The construction industry in particular could profit from demographic change. Modular and flexible buildings with intelligent, variable, IT-based in-house communication and technology systems could increase the quality of life of older people. Private and public educational institutions should establish comprehensive programmes for all age groups. Information and knowledge are important resources for the future and they need to be expanded regularly.

Health, Prevention of Illness and Health-Care: Health-preservation will play a key role in our future health-care systems. It will be an inherent part of the educational system as well. Private wellness and prevention services will find new markets. Home care will become more important. Innovative technologies and services make a system of health care within the social environment possible. The rising importance of health and prevention opens up new markets for the pharmaceutical industry, for providers of medical equipment, and for alternative medicine. The economy of Rheinland-Pfalz must realise this trend rapidly and benefit from it.

Tourism, Leisure and Culture: Rheinland-Pfalz should better promote its highlights to an international audience clientele - its wine culture, attractive landscape and cultural monuments. Tourism offers should be better targeted for groups such as young families and senior travellers. An extended network of actors in tourism, culture and recreation could allow comprehensive and transparent offers for travellers to Rheinland-Pfalz. In co-operation all such organisations could more easily create new market opportunities.

Implementation in Progress

The measures proposed as a result of this foresight exercise provide the basis for an ongoing in-depth discussion with decision-makers and relevant actors involved in politics, society and the economy. In numerous workshops, guiding principles and recommended actions are connected to concrete needs of well defined regions and special economic sectors.

This foresight exercise provided an effective and favourable tool for dealing with the issue of demographic change in Rheinland-Pfalz.

Sources and References

All guiding principles and the complete set of scenarios and recommended actions can be found on the following site:
www.zukunftsradar2030.de.

East German Cross-Border Regions 2020

Authors:	Anette Braun of the Future Technology Division at VDI TZ-ZTC / braun_a@vdi.de		
Sponsors:	The Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung or BMBF)		
Type:	Conference for the National investigation of regional foresight processes in East German border regions		
Organizer:	VDI TZ Future Technologies Division in cooperation with Fraunhofer ISI		
Duration:	2004-2005	Budget: N.A.	Time Horizon: 2020

Motivation

Despite the progress they have made to restructure and modernize, Eastern German regions today still lag clearly behind most regions of Western Germany. For this reason there is a need for a specific East German Innovation Policy. This has led the Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung of BMBF) to supplement federal innovation programs in support of East Germany with a Regional Foresight exercise.

Unleashing Innovative Potential with Regional Foresight

In recent years, regional initiatives and activities have gained great significance due to the adoption of holistic approaches to dealing with employment and structural adjustment to local economies.

In the 'new' German Länder numerous regional and local initiatives and alliances endeavour to overcome the immediate problems caused by structural change and develop a regional profile better shaped to meet the challenges of the future.

Such regional initiatives and alliances are usually characterised by a high level of motivation, strong commitment and deep knowledge of current problems. In some cases they are characterized by broad participation of citizens and stakeholders. In general they are doing pioneering work in the field of structural policies.

A recent initiative on 'Regional Foresight in German Border Regions' funded by the Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung or BMBF) was concerned with the exploitation of the potential of regional foresight in the cross-border regions of Germany, Poland, and the Czech Republic.

'Aufbau Ost' and the Development of Eastern Germany

When Germany celebrated its unification on 3 October 1990, large sections of East German economy were highly unprofitable. 'Aufbau Ost' is a programme for economic recovery in East Germany . Literally it means 'Development of Eastern Germany' and the German Government funds research projects which focus on specific issues that affect the new federal states.

In particular the Federal Office for Building and Regional Planning (BBR) coordinates and supervises projects, which thematically focus on Regional Development, Location Development, Housing and Building .

Since 1999 the Federal Ministry of Education and Research or BMBF has been supporting regional alliances in the new German Länder . The focus is on the development of 'Entrepreneurial Regions' through regional competencies, activities with a high innovation potential and a high technological content.

As a result in the eastern states of Germany a modern economic structure is emerging that is geared towards the future.

The intention of this BMBF initiative was to introduce the concept of 'Regional Foresight' into the vision for 'Aufbau Ost' and lay the foundation for regional innovation strategies with the broad objective of foster growth and employment through trans-regional cooperation.

Cross-border Innovation Strategies

Under the title 'Border Regions – Regional Foresight and Innovation Development in Eastern Germany' a conference was organised by the BMBF in 2004-2005 focusing on how regional forward-looking initiatives in three Eastern German cross-border regions could make a valuable contribution towards innovation and act as a springboard for joint strategic action.

The geographical focus was on **Upper Lusatia, Havelland-Fläming and South Thuringia.**

The main question was whether 'Regional Foresight' a relatively new tool for the management of innovation at regional level, could contribute to the development of the regional innovation system.

In the context of this initiative the term 'Border Region' was taken literally and referred to regions at the eastern border of Germany. However it also had a more figurative meaning in that it also referred to regions in which an economic divide act as a specific barrier to development. On this basis the following border regions were analysed:

- **Upper Lusatia (Oberlausitz):** Situated in the border region close to the new EU member states Poland and the Czech Republic, it represents a border region with a relatively low level of economic development, yet a high level of planning activity some of which is trans-national in nature.
- **The Havelland-Fläming:** This region is close to the major conurbation of Berlin and is characterized by its proximity to a highly developed metropolitan area.
- **South Thuringia:** This region borders the 'old' federal states of Hesse and Bavaria. It thereby represents a border situation with great proximity to Western German regions.

The survey conducted on regional foresight processes in the border regions of East Germany, pointed out commonalities and differences in the effectiveness of innovation and cross-border strategies, especially when these were carried out as a complement to conventional problem solving strategies at regional level.

Broad Participation Needed

It became clear that in the three analysed regions the aims of most of the foresight initiatives dealing with innovation strategies could not have been effective without the commitment of a broad range of actors from industry as well as citizens.

Although the individual situation of these border areas differs substantially from one region to another, all hitherto conducted foresight initiatives resulted in the revitalisation of common potentials on both sides of the border.

In **Havelland-Fläming** it was emphasised that regional foresight initiatives made a constructive contribution to achieving the aims of the innovation strategy. It was also made clear that regional foresight initiatives could be of significant importance for shaping a shared vision of the future for the border region. The:

- Exchange of experience,
- Implementation of common projects, and
- Mobilisation of civil society,
- Enables the:
- Reasonable and economical administration of financial resources,
- Avoids duplication work, and
- Evokes a sustainable political will.

In **South Thuringia** the use of regional foresight in planning activities was considered to have a very progressive influence on the development of innovation strategies. This was especially true for the implementation of so-called 'Lead Projects' which enjoy great visibility at regional level. Regional foresight was considered a good tool for developing cross-border cooperation. It was observed that region both lose and gain from a geographical situation of sharing a border with one or more of the 'old' federal states. A common, cross-border orientation is of central importance in optimising this situation so as to enhance advantages and mitigating the disadvantages that arise from the cross border economic divide.

Regional foresight planning in **Upper Lusatia** and Lower Silesia was especially welcomed by actor and other stakeholders. These regions had positive experiences in cross-border cooperation using foresight for the development of common strategies. Their impression of the effectiveness of applying regional foresight in planning innovation strategies was very positive.

There were however some points of criticism concerning the use of foresight and its appropriateness.

- Some actors expressed frustration that broad-based participation of citizens and actors alone 'did not necessarily create jobs in the region'.
- Some felt that the visionary nature of a foresight initiative 'was not always compatible with the actual mood in the Upper Lusatia region'.

Importance of Foresight in the Field of Policy-making

These surveys and discussions lead to the conclusion that Regional Foresight is:

- A medium for dialogue involving citizens and private industry,
- A tool for regional planning,
- Sensitive to the effects of mega-trends on regional development,
- Supportive of active, society-oriented commitment of the region for the region,
- An appropriate way to increase the effectiveness of planning for regional innovation activity.

In spite of the increasing importance of foresight in the field of policy-making, foresight activities analyzed in this initiative have not yet reached the same degree of integration or complementarity and interrelation as other instruments for the development of regional innovation systems. This is due to the fact that in some regions foresight activities are hardly visible and networking of key actors barely occurs if it happens at all.

In the regions we have analyzed there is a clear need for a supporting framework for these activities, one that applies on the European level as well as on the level of the region. More precisely there is a need for mobility and funding instruments and programmes within a network of actors involved in foresight. Thus, the actors in society and industry will be able to proactively face up to and react to the accelerated technological change and to the challenge of globalisation.

Recapitulating the following needs have been identified. There is a need for:

- An efficient and effective interregional and if possibly EU-wide network of foresight activities,
- The development of a coherent supporting framework that guarantees the systematic use and optimal implementation of foresight processes,
- The identification and mobilization of all relevant actors at all levels of governance levels.

Better Linkage and Consolidation of Foresight Engagement Required

During the conference that was part of the BMBF initiative on regional foresight in East Germany's border regions, a wide range of foresight activities were identified that stimulate and project the systematic anticipation of socio-economic and technological developments. A great variety of different actors were identified that participate in and contribute towards the activation of endogenous development potentials through processes such as identity building. With participatory approaches such as regional foresight it is possible to achieve not only the systematic integration of existing pubic and private initiatives, but also the bottom-up development of regional strategies concerning the future.

Nevertheless it was felt that public decision makers, small and medium sized enterprise in the region as well as actors from research and science could be better linked. It was felt that science-industry links are of particular importance. By re-examining the role of each of the both public and private sector players, by establishing synergies between activities and by taking advantage of complementarities among initiatives at European, national and regional level, a reinforced partnership among all those involved should be achieved.

Regional Strategic Intelligence Empowered by Cross-border Mutual Learning

The project focused on the stimulation and optimization of innovation activities in 'border regions'.
The central characteristic of border regions is the convergence of economic, social and cultural contexts in a single region. This creates the potential for conflict and obscures opportunities for innovation.

Particularly for East German regions bordering on Eastern Europe, EU enlargement offers vast possibilities. However these are often difficult to appraise. Regional actors must be mobilized to include these opportunities in their strategic planning.

A large number of East German foresight projects give rise to the assumption that regional foresight in a cross-border context is an effective instrument for transnational, cross border and interregional democratic processes of civic participation in thinking, debating and shaping the local future.

Regions in 'border-like situations', which are not necessarily located at geographical borders, but have historical, interregional links, through migration or commuting flows, could learn from these examples. Just as in the case of technological innovation, the new opportunities lie at the interfaces of disciplines, the meeting of different cultural and socio-economic spheres can lead to 'social' innovation.

The process of developing common visions and future strategies in cross-border and transnational regions is broadly promoted by interregional prospective and strategic initiatives that concurrently consider the many aspects of European integration at the local level.

While integrating global mega trends and already acquired know-how on technological, market-relevant and regional developments, regional foresight can be used to elaborate approaches to and visions for developments which promise to have the biggest impact on decision-making in a given region.

By stimulating a socio-political dynamic, relevant trends can be recognized and harnessed for the benefit of the region. This obviates the need for the implementation of a highly participatory process such as regional foresight.

These comparatively independent regional strategy-relevant processes are aimed at linking key actors of a region such as decision-makers, scientists, enterprise representatives and project promoters in completely new constellations and they encourage more extensive co-operation.

Foresight for Social Innovation

In order to create a climate in which innovation can occur and innovation systems evolve, existing structures and established knowledge must be continuously challenged. Foresight as a tool for 'social innovation' is inextricably linked to a path towards more open societies in which every community and every generation develops its own vision and periodically defines anew where it wants to go and what its future is going to look like.

By incorporating strategic foresight in planning and by using regional analysis combined with participative or interactive methods for collecting future relevant information and vision-shaping, cross-border regions in particular may facilitate immediate and future decisions and common activities.

This does not mean that we should replace established planning methods. It means that we should add new dimensions of decision-making and communication to existing methods, thereby supplementing the activities of the regional actors, broadening their horizons and increasing their strength.

Sources and References

Innovation Support Initiative for East Germany of the Federal Ministry of Education and Research - (BMBF): **www.unternehmen-region.de**

Examples for regional Foresight Initiatives in Germany and Europe: **http://www.unternehmen-region.de/de/1219.php**

Braun, A., Zweck, A.: Regionale Vorausschau (Foresight und Zukunftsinitiativen) in Deutschland, Übersichtsstudie (Band 45) Hrsg.: VDI-Technologiezentrum; 2002. **ftp://ftp.cordis.lu/pub/foresight/docs/cgrf_de_2003.zip**

Sensor Technology Foresight in Denmark – 2015

Authors:	Birgitte Rasmussen / birgitte.rasmussen@risoe.dk Per Dannemand Andersen / per.dannemand@risoe.dk		
Sponsors:	Sensor Technology Center / www.sensortec.dk		
Type:	A national technology foresight aiming at strengthening industry's, organisations' and policy maker's strategic outlook on sensor technology		
Organizer:	Risø National Laboratory, Roskilde Denmark / www.risoe.dk		
Contacts:	Birgitte Rasmussen / birgitte.rasmussen@risoe.dk Per Dannemand Andersen / per.dannemand@risoe.dk		
Duration:	2000-2001	Budget: € 114 000	Time Horizon: 2000-2015

Purpose

The overall goal of this foresight on sensor technologies was to provide scenarios for future developments in sensor technology in terms of the technology itself, its application and relevant markets for the period 2000–2015. This was to provide a decision support tool to prioritise research and development and to guide the commercialisation of sensor technology in the near future. It was also intended to develop and maintain networks of expertise within the sensor technology community and to test elements of technology foresight methodology applied to a narrow technology domain.

Sensors for Future Technologies and Markets

Sensor technology is one of the technologies that will play a major role in the future. It can be used in all sectors of industry to give products added value that make them more competitive. Sensor technology is a rapidly growing area of research. Many products incorporating sensor technology are already on the market and it promises to continue to play a critical role in technologies of the future.

Sensors and sensor systems perform a wide range of sensing functions. They enable products and systems to capture process and communicate information about the status of the system in which it is placed. Sensors are able to capturing information on the chemical composition, texture and morphology, large-scale structure, position and motion of systems in which they are applied. It is a characteristic feature of a sensor that the device is tailored to the environment in which it is to operate.

The Danish government established a dedicated sensor programme in 1999 and provided approximately € 14M over a 3 year period to support research and development of sensor technology. This foresight project was an important early part of that initiative. The target group for the foresight study was the Danish sensor technology community. This included manufacturers and users of sensors, the R&D community, public authorities and the Sensor Technology Center - a consultancy centre for the industrial sector.

Project Structure

The project comprised six main tasks:
- **Technology Mapping:** This involved desk research to identify the boundaries and categories of the technological landscape to be analysed.
- **Technology Premises:** An expert panel was set up to establish the state-of-the-art in sensor technology and to define boundary conditions for sensor technology over the next 15 years.
- **Case Studies:** These were used to analyse important mechanisms for sensor technology breakthroughs.
- Technology and Market: An expert panel was set up to develop a future oriented discussion on trends in the development of sensor technology and the interaction between the market and technology over the next 15 years.
- **Survey:** This was performed to improve validity and reliability of the preliminary conclusions of the foresight.
- Conclusion: Discussion and processing of the various elements of the previous tasks employing technology

mapping and scanning, case studies, expert panels and the survey.

Data Collection

The collection of data and information for the synthesis of possible future developments of sensor technologies were structured along three axes:

- Sensor physics and sensor systems,
- The generation and transfer of expertise and skills,
- Technology users and areas of application.

The study analysed six categories of sensors:

- Electromagnetic,
- Mechanical,
- Electrical,
- Magnetic,
- Chemical,
- Nuclear.

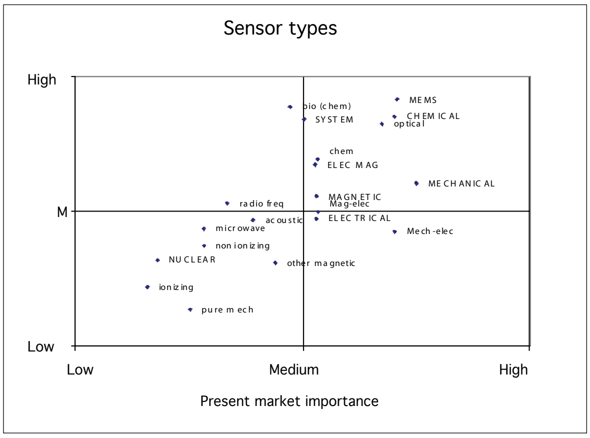
These covered 13 sub-categories in addition to a number of systemic issues. The scanning process was concerned with 'looking ahead' and was followed by detailed technology mapping. Scanning was performed by examining topics in the available literature and through four thematic expert workshops. Two of these were Danish workshops and two international workshops one on 'Technological Premises' and the other on 'Technology and the Market'. In structured brainstorming sessions experts were asked to formulate statements and visions about trends in sensor development. It was intended that these statements should reflect issues identified during the technology mapping. The experts were therefore asked to follow a syntax that referred to the following elements:

- Development stage,
- Sensor type,
- Basic technology,
- Area of application.

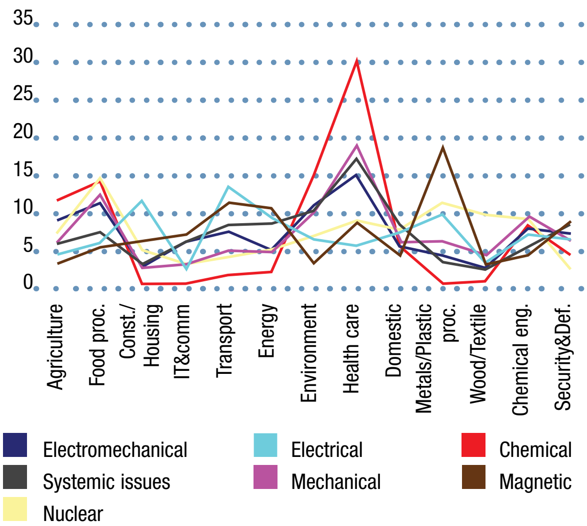
This scanning process resulted in a list of 217 topics and statements central to the future development and use of sensors.

The Delphi Survey on Sensors

A Delphi survey was performed in order to improve the validity and reliability of the preliminary results. The questionnaire cannot be too long or burdensome to complete and the number of statements should therefore be limited to about 50. The Delphi survey asked experts to respond to each statement in terms such as the time horizon or barriers for realization and the potential market volume. 130 statements were formulated on basis of the 217 topics arising from the data collection process and these were narrowed down to a final 50 used as the basis for the Delphi questionnaire. The following diagram summarizes the results of the survey in terms of the present and future market potential of different sensor types.



The next diagram summarizes the results of the survey in terms of the expected impact of different sensor technologies on markets linked to specific application domains.



Approximately 1000 sensor experts received the questionnaire and 174 responded. Comparing with other international experience the response rate of about 17% is neither high nor low. Half of the respondents came from academia and more than one third came from industry. 90% of the respondents came from Europe, of which the largest group came from Denmark (38%).

The Strongest Market Prospect is Health Care

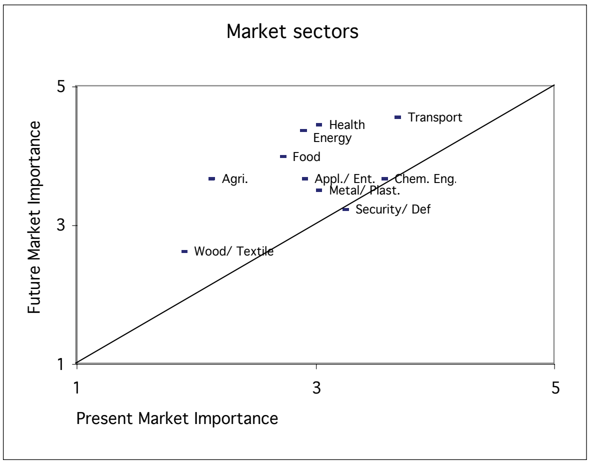
One of the questions in the Delphi questionnaire concerned 'Market sectors most heavily impacted by the statement'. For each sensor type the number of respondents has been normalised resulting in a market impact index.

A general conclusion is that the market sector most heavily impacted by new sensor technology will be healthcare.

It also appears that new sensor technology will affect food processing and the environment. It will have less impact in sectors such as construction and housing, wood or textiles. All sources of information - literature, workshops and questionnaires indicate the same pattern regarding the future attractiveness of sensor types. MEMS (Micro-Electro-Mechanical Systems), optical sensors, and biochemical or biological sensors together with sensor systems are all expected to be the most interesting sensor types over the next 10 years in terms of market volume.

Increased Use Expected in All Sectors

The issue of how the expected future market importance compares to current market importance was evaluated in an expert workshop. In the figure below, market sectors above the diagonal line correspond to rising sensor markets. Markets on the line are expected to remain for a while at the status quo. As can been seen from this diagram the prognosis is for increased use of sensors in nearly all markets of application.



The Future of MEMS and Integrated Systems

It is possible to rank survey results according to different variables with a view to identifying lists of 'top-ten' technologies.

A top-ten list of technologies was prepared on the basis of the combined index of technological feasibility and potential market volume among expert and knowledgeable respondents. This list comprises refers to all types of sensors, except electrical and nuclear sensors.

MEMS in particular stand out together with sensors that are small, low cost, and flexible. MEMS refer to Micro-Electro-Mechanical-Systems, in particular to physical sensing devices that are of the order of a micrometer in size and are integrated with signal processing technologies using silicon fabrication techniques. It is also expected that sensors will be developed as integrated systems that can be used for multiple applications.

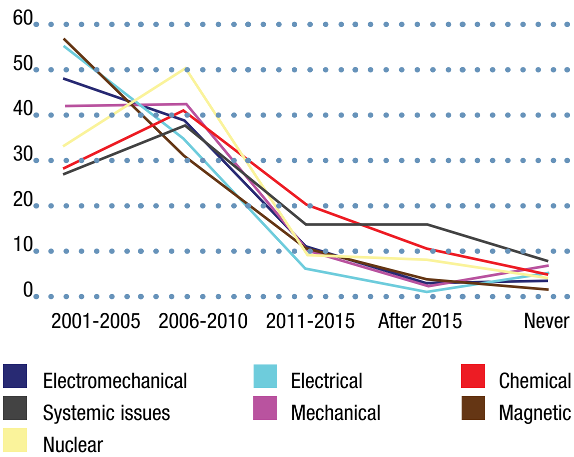
The markets most influenced by the future development of sensors vary as a function of sensor type. Biosensors for example will have a significant impact on the food and health markets. These markets will also be affected by developments in MEMS.

The study revealed that the most important barriers to realizing expected technological developments in sensor technology are limited cross-disciplinary collaboration, limited cross-sectoral collaboration, and a lack of qualified human resources. For the topics on sensor communication and motion control, the lack of standardization is also highlighted as a barrier. Limited cross-sectoral collaboration is especially emphasized as a barrier in topics on MEMS and measurement of water quality.

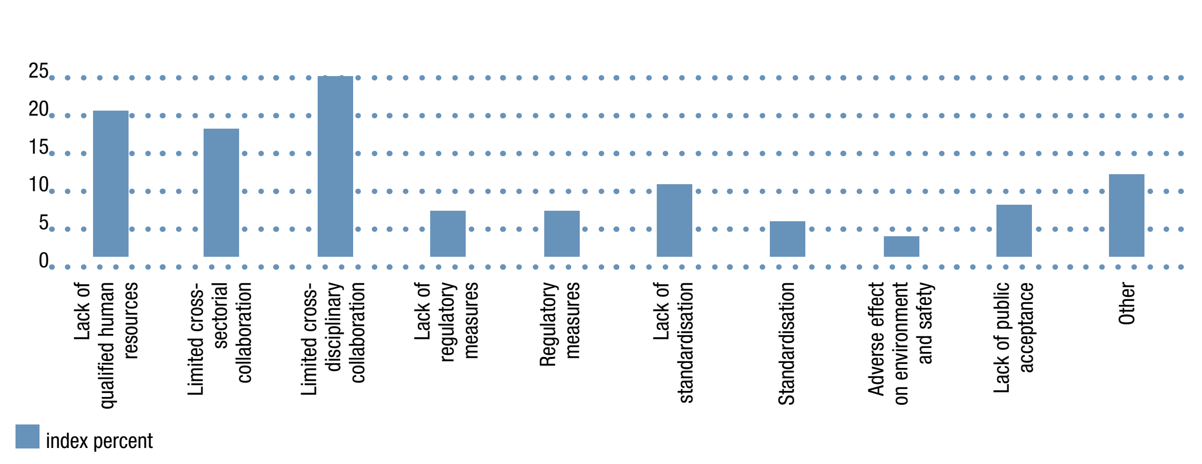
The study also revealed conflicting assessments of the future for biosensors. On the one hand the widespread use of biosensors, in particular DNA sensors, is considered likely. On the other hand however the use of implanted bio- sensors and human-like sensors was considered unlikely and ranked at the bottom of a technological feasibility list. This at least partly contradicts the positive assessment of their potential market impact.

When Will All This Happen?

The diagram below indicates results from the Delphi study on when experts expect specific sensor types to become available for application.
The general opinion is that most of these sensor types will have been developed by about 2011.



This is not surprising given the focus on practical and widespread use in many of the Delphi statements. Respondents felt that 39% of the topics would be realized between 2006 and 2010, 37% between 2001 and 2005, and the remaining topics after 2010. 4% of the technology



developments were expected never to occur. An analysis of developments that 10% of knowledgeable responses considered would 'never' occur three stand out as particularly unlikely. All of these events concerned biosensors in stages of development that ranged from development to practical use. Comparing the 'never' responses with those at the bottom of the list for technological feasibility and potential market volume, revealed some conformity with results for implants and the use of sensors for human perception.

Limited Collaboration is Seen as a Major Constraint

The realisation of stated events can be constrained by a variety of framework conditions central to the development of the technology and its markets. The study revealed that the most important barriers to realising the expected developments in sensor technology are limited cross-disciplinary collaboration, limited cross-sectoral collaboration, and lack of qualified human resources. On the topic of sensor communication and motion control, the lack of standardisation was highlighted as a barrier. Limited cross-sectoral collaboration was given special emphasis as a barrier to development of technologies such as MEMS and the application of sensor technology to measurement of water quality. Some attention was paid to the lack of regulation. In particular this was seen as a barrier for the development of automotive and optical gas sensors, as well as implants and biosensors. Public acceptance was deemed a factor in the case of implanted sensors and the use of X-ray sources for sensing in industrial processes. The following diagram gives an overview of expert response on barriers.

Discussion and Lessons Learned

The results of the project and its final report were presented to an invited group of stakeholders and their comments typically fell into three categories.

- Marketing people and professionals from firms importing and distributing sensors felt that the survey gave them a good overview of current technological trends in the area. They indicated that the study provided a foundation for change in their sensor-type portfolio. This group consisted primarily of small and medium-size firms with limited resources to carry our larger foresight and strategy processes of their own.
- People from research and industry with a deep knowledge of sensor technology typically said that they learned nothing new in their own area of expertise. This indicates at least that the final result does not contain any major large flaws or misinterpretations. It also indicates that technology foresight projects at this level of focus do not target the needs of sensor experts but a more user.
- Several representatives from larger firms with a tradition or experience in strategic thinking found the methodology was interesting and requested more information on the process.

Sources and References

- Dannemand Andersen, P.; Jørgensen, B.H.; Lading, L., Rasmussen, B. (2004). "Sensor Foresight - Technology and Market", TECHNOVATION, 24/4, 311-320.
- Dannemand Andersen, P.; Jørgensen, B.H.; Rasmussen, B. (2001). Sensor Technology Fore¬sight, Risø-R-1292(EN). 57 pp. + appendices
- **http://www.risoe.dk/rispubl/SYS/ris-r-1292.htm**

Danish Nano-science and Nano-technology for 2025

Authors:	Birgitte Rasmussen / birgitte.rasmussen@risoe.dk Per Dannemand Andersen / per.dannemand@risoe.dk
Sponsors:	The Danish Ministry of Science, Technology and Innovation
Type:	A national technology foresight project with the purpose of anticipating the range and scope of nano-scientific and nano-technological development in Denmark over the next 20 years.
Organizer:	Risø National Laboratory, Roskilde Denmark / www.risoe.dk
Contacts:	Birgitte Rasmussen / birgitte.rasmussen@risoe.dk Per Dannemand Andersen / per.dannemand@risoe.dk
Duration:	2004 – 2004 Budget: € 134 000 Time Horizon: 2005-2025

Purpose

The purpose of this Technology Foresight on nano-technology was to provide knowledge regarding the scope for nano-scientific and nano-technological developments over the next 20 years, as a basis for the development of a cohesive, long-term policy for research, education and innovation in this area. The delivery of an action plan for Danish nano-science and nano-technology containing recommendations for the next few years was the most essential task in the project. The target group consisted of the Danish Ministry of Science, Technology and Innovation and the Danish system of advisory and grant-awarding bodies for research and innovation.

Why make it a National Priority?

The aim of the Danish technology foresight was to provide a sound basis for cohesive, long-term Danish policy on research, education and innovation. In large countries like the US, Japan and China, annual investments running into many billions of dollars are already being made across wide areas of nanotechnology. Denmark cannot match figures of that kind. Instead the intention has been to focus carefully on the implementation of targeted long-term initiatives where Danish economic and societal interests are clear and where Denmark enjoys particular research and industrial advantages and scope.

A few months after this foresight project started the Danish government announced the establishment of the High-Technology Foundation. The aim of this new foundation is to strengthen growth and employment by supporting strategic initiatives in high-level technological research and innovation such as nanotechnology, biotechnology, and information and communication technology. This government initiative attracted a lot of attention to the foresight study on nanotechnology, especially from research environments.

Steering Group

The project was undertaken by a Steering Group appointed by the Danish Ministry of Science, Technology and Innovation. The Steering Group had seven members and included representatives from nanotechnology industry, nano-science and social science. A team from Risø National Laboratory acted as methodological adviser and process consultant for the project. The Ministry of Science, Technology and Innovation provided the secretariat for the Steering Group.

Domain Classification

'Nano-technology' is defined as the ability to work at the atomic, molecular and supra-molecular levels at a scale of 0.1–100 nm for the purpose of designing, manufacturing, manipulating and applying materials, components and systems with new physical, chemical and biological functional properties. These new properties emerge because of the small scale of the structures, and can therefore not be obtained in other ways. Integration with other scales of length and areas of application will often be essential to technological applications.

'Nano-science' is concerned with obtaining an understanding of 'fundamental phenomena, properties and functions at the nano-scale, which are not scalable outside the nanometre domain'. The domain was divided in three subcategories nano-bio-systems, nano-electronics & nano-optics, and nano-materials. These subcategories structured the main activities in the foresight process. The Steering Group was well aware that these necessary simplifications could require adjustment at a subsequent stage in the process.

Hypotheses on Future Research and Industrial Impact

Nanotechnology is an emerging technology currently in an early, very exploratory creative phase. Wide industrial application lies many years ahead. Existing enterprises will have a future business interest in nanotechnology but a large number of new enterprises are likely to appear in the coming years.

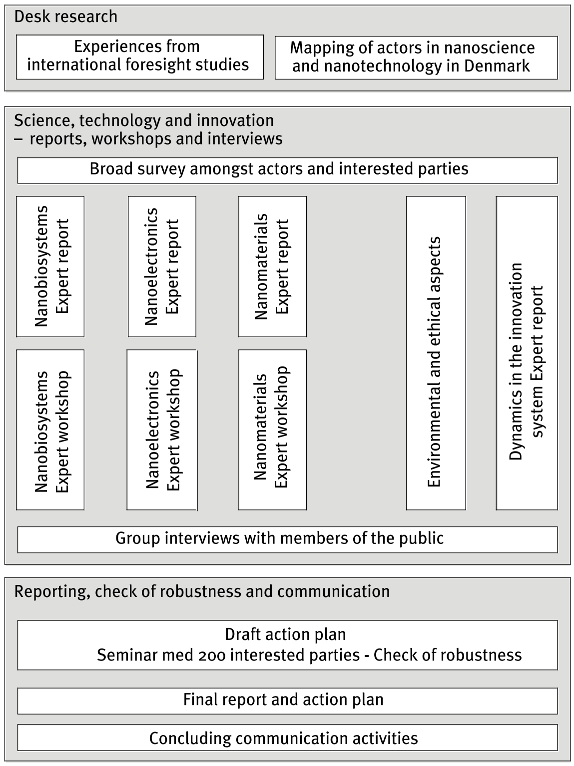
Important building blocks in the Danish Nano-foresight process were hypotheses and statements about future research, industrial possibilities and consequences both beneficial and adverse of nano-science and nano-technology. These hypotheses and statements were systematically gathered from international technology foresight projects, Danish research environments and expert reports. They were discussed in subsequent workshops with attention to time-horizon, industrial scope, possible adverse consequences and policy implications. The process had the following key elements:

- Review existing foresight on nanotechnology,
- Map Danish nano-science and nano-technology,
- Survey interested parties,
- Commission expert reports,
- Hold workshops based on these reports,
- Analyse the dynamics of innovation in these fields,
- Survey hazards, environmental and ethical issues,
- Open interviews with members of the public.

The separate components and their interrelations and sequence are shown in the project diagram (right).

Findings and Lessons Learned

A basic concept in the process was the formulation of statements. The intention of the process design was to build the foresight on a systematic collection of statements or hypotheses about the scientific and commercial potentials of nanotechnology within a time horizon of 20 years. Subsequently, these statements/hypotheses were to be exposed to critical scientific discussion. The lesson learned was that the experts and actors were not familiar with the approach to thinking found in statements.



The expert papers show that the project group extracted 91 statements; a further 149 were extracted from responses to the internet survey. At the workshops, the statements were commented on, and a real-time Delphi questionnaire was filled in at the end of each workshop. The project concluded on 7 high-priority areas of technology. In the table below 32 statements are listed concerning applications of these 7 areas.

The concluding Action Plan mentions a number of examples of future nano-technological possibilities in seven high-priority technology areas. For most of the examples, consideration was given to the likely time horizon within which the possibilities could be realized. This was based on the three Expert Reports, the broad survey amongst interested parties and the three workshops. It is important to emphasize that these are not predictions they are estimates and are intended as a tool to facilitate further discussions.

Nano-Medicine and Drug-delivery

- Intelligent drug delivery systems to monitor the state of cells in the body and report events such as cancer or small blood clots.
- Self-assembling nano-capsules made from functionalised polymers for cell-specific recognition, controlled release of active substance and concealment of the particle from the body's immune system.
- Biocompatible materials for drug delivery to applications that require slow release due to time for passage through the blood-brain barrier.
- New types of drugs based on nano-scale interactions and

structural assemblies for example for the self-assembly of peptides and DNA strands into bioactive complexes.

Biocompatible Materials

- Development of nano-biotechnology for the repair of defective neurons by the application of electrically conducting nanostructures.
- Practical application of synthetic surfaces with biological properties for use in implants, prostheses and medico-technical equipment.
- Practical application of nano-designed surfaces to promote or inhibit adhesion for example of bacteria or algae in antifouling products.

Nano-Sensors and Nano-Fluidics

- NEMS (Nano-Electro-Mechanical Systems) for selective detection of specified molecules or cells, measurement of heat or binding energies.
- Development of very efficient, distributed sensor systems that combine CMOS and NEMS, that communicate using wireless technology and can be used in applications for environmental monitoring, process control, indoor climate control and traffic safety.
- Practical application of "lab-on-a-chip" systems based on nano-optics and nano-fluidic liquid handling systems for point-of-care diagnostics.
- Practical application of implanted sensors for monitoring infections.

Polymer Electronics

- Polymer electronics for displays and sensors integrated into packaging, for monitoring the condition and history of goods in transit and storage.
- Polymer transistors integrated into single-use equipment for analytical purposes in primary health care.
- Multicoloured plastic displays instead of liquid crystal displays.
- Polymer FETs or Field Effect Transistors for RFID tags
- Polymer electronics and optics for solar cell technology.

Nano-Optics and Nano-Photonics

- Fibres micro-structured in their longitudinal direction for use in high-power lasers for welding, light sources in large displays, super-continuum-generating units and optical communication systems.
- Compact, low-price nano- or micro-structured plane components with integrated optical circuits based on photonic band gaps with application to sensor systems and fibre-to-home technologies.
- New sensors and optical switches based on filling the fine structure in optical crystal fibres with liquids, coatings or liquid crystals.
- Signal processing based on PBG structures with built-in non-linear optical elements for modulation, wavelength conversion, four-wave mixing and optical conjugation.

Nano-Catalysis, Hydrogen Technology ...

- The use of in situ, theoretical and other methods to create tailored catalysts and other functional nano-materials.
- Chemical approaches to hydrogen storage based on use of methane, methanol or ammonia or in the form of metal hydrides and using new materials that incorporate nano-technology and nano-particles.
- New, cheaper, longer life SO and PEM fuel cells.
- Development and improvement of catalysts based on natural enzymes, efficient at low temperatures and pressures.
- Specific catalytic Nano-systems for the breakdown of pollutants in nature using pre-organisation of reagents, catalysis and product release.

Nano-Materials with New Functional Properties

- Alloys or ceramic materials that crystallise with very small grain size to give high strength and good workability for use in high-value products, from the micro to macro scale, such as implants and sports equipment.
- Nano-composites with greater properties than pure polymers for corrosion resistance, sound absorption, and ease of recycling.
- Functional products made from woven and non-woven polymer fibres.
- Coatings with built-in chemical functionality obtained from nano-particles or a nano-structured topology.
- Block co-polymers for self-repairing surfaces.
- Nano-porous materials as filters in the food and drink industry.
- Thermoelectric materials with radically improved properties for cooling and energy production, based on nano-sized structures.

The Strengths and Weaknesses of Danish Nano-science

Danish strengths include:

- An internationally respected scientific research environments in quantum physics, biochemistry, optoelectronics, scanning probe microscopy and X-ray diffraction, and other fields or importance for nano-science,
- It is well-equipped for cross-disciplinary research,
- It has obtained an early start with the development of nano degree courses for research,
- It has relatively new and up to date production facilities.

On the other hand the Danish context suffers from the following general weaknesses:

- Denmark has a weak tradition for synthesis and technology development,
- Danish universities do not have a strong tradition for the

commercialisation of research results or for the handling of patents and other IPR,
- Denmark has a weak entrepreneurial tradition,
- It suffers from a shortage of persons able to combine science and business,
- It does not have a tradition for large focused investment programmes,
- There is limited mobility between Danish research institutions and between the worlds of research and industry.

Envisioning Denmark as One of the World Leaders in ...

The Steering Group's vision is that towards 2020 Denmark will be among world leaders in mastery of nanotechnology within selected areas. In selecting focus areas the Steering Group adopted the following criteria: a) Industrial and societal relevance. b) Research strengths and/or potentials. c) Global industrial, research or societal importance

Action Plan

A co-ordinated strategy for nano-technology needs to include a broad range of initiatives. The Steering Group provided the following recommendations:
- **Prioritise Technology Areas:** Support should be given to technology areas in which Danish enterprises and research environments are at the international forefront. High-priority areas of technology in non-prioritised order include:
  - Nano-medicine and drug delivery,
  - Biocompatible materials,
  - Nano-sensors and nano-fluidics,
  - Polymer electronics,
  - Nano-optics and nano-photonics,
  - Nano-catalysis, hydrogen technology, etc.
  - Nano-materials with new functional properties.
- **Create Interplay between Nano-technology Research and High-tech Industry:** Three types of initiative are expected to further nano-technological and nano-scientific research and development and appropriate links to industry. These are high priority linitiatives, visionary linitiatives and exploratory projects.
- **Establish Nano-technology Centres for Strategic Research and Innovation:** National investment should take the form of a concentrated programme that creates and supports entities with real international impact. It was recommended to establish two national nanotechnology centres for strategic research and innovation. These must have the critical mass to become international scientific and technological leaders in their field.
- **Increase Numbers of Graduates from Higher Education and Researchers:** Increased commitment to nano-science and nano-technology requires the availability of sufficient numbers of qualified MSc graduates and researchers. The training of graduates from higher education is an important mechanism for knowledge transfer between companies and research institutions.
- **Sensitise Danish Enterprise to the Future Role of Nano-science and Nano-technology:** Danish industry must be able to participate widely in the industrial revolution brought about by nanotechnology. Special efforts are required to provoke the interest of new and established enterprises in the possibilities offered by this domain.
- **Address Potential Hazards, in particular to Health, Environmental and Ethical Consideration:** The Steering Group recommended that grants be coupled to a requirement for nano-technology related risk assessment that covers production, use and subsequent disposal of nano-technologies as well as a comparison with alternative approaches. Denmark should urge the EU to take an active role in this area.

From Foresight to R&D Program

The foresight report was published and the specific recommendations were disseminated to individuals in the target group. Some recommendations have already been used in decision-making on R&D funding and have provided input to the strategic deliberation of publicly funded R&D institutions. Others are expected to be used for decision-making whereas some are being discussed in research councils and ministries. Others are being investigated and developed further.

Both the foresight process and the publication of the final report have created broader awareness and debate among researchers and decision makers about the hazardous aspects of nanotechnology. The relevant authorities and institutions are now examining these questions more seriously.

Sources and References

Technology Foresight on Danish Nanoscience and Nanotechnology. Action Plan. 2004, Ministry of Science, Technology and Innovation, 50 pp.

Background Papers (in Danish)
http://www.teknologiskfremsyn.dk

Dannemand Andersen, P.; B. Rasmussen, M. Strange, J. Haisler: Technology foresight on nanoscience and nanotechnology. Forthcoming in Foresight (Emerald).

Austrian Safety and Security Research 2011

Authors:	Claus Seibt, Ronald Bieber and René Mittringer of ARC systems research GmbH with Thomas Huemer and Alfred Vogel of Austrian Academy of Sciences in Vienna. Contact Claus Seibt at Claus.Seibt@arcs.ac.at or Thomas Huemer at Thomas.Huemer@oeaw.ac.at		
Sponsors:	The European Commission		
Type:	A national foresight to develop a proposal for an Austrian Safety/Security research system		
Organizer:	The BMVIT - Austrian Federal Ministry for Transportation, Innovation and Technology		
Duration:	2005	Budget: € 120 000	Time Horizon: 2007-2011

Motivation

Austria intends to launch a national research programme on safety and security that is complimentary to PASR – an EU funded Preparatory Action on Security Research as well as the upcoming Seventh Framework Programme of the European Union. To prepare the ground for this new national research funding initiative, a foresight process was started to investigate conceptual issues concerning safety and security research and to identify Austrian priorities for research in this area. This initiative was coordinated by the Federal Ministry for Transportation, Innovation and Technology of Austria.

International Frameworks and National Contexts for Research on Safety & Security

The first aim of the project 'Safety/Security Research – Idea and Procedures for Austria' was to complete a comprehensive conceptual investigation of this research area. The second was to employ a bottom-up foresight approach for the identification of research priorities for safety and security research from an Austrian point of view.

The terms safety/security refer to a broad set of themes ranging from personal safety to collective safety and security. However safety/security research should be approached from within an international framework that remains open to news ideas, concepts and needs while respecting the national context.

Twenty half-day workshops were organised with the involvement of representatives of relevant public authorities and national research domains, stakeholders from the Austrian provinces and federal ministries. This campaign marked the start of the foresight process.

The Project Schedule

The project was organized as a sequence of five phases.
Phase 1 – Investigation of the Status Quo and Further Requirements: In this project phase the most relevant national policy actors and public authorities were involved along with representatives of research organisations, representatives from industry and trade unions as well as business councils and international organizations such as OPEC and the UN. More than 150 experts contributed about 1,300 statements in 20 half-day workshops to provide a broad cross sectional database of opinion on security and safety issues.

Phase 2 – Data Structuring and Ordering: The plethora of data from the first phase was structured and ordered by a list of keywords extracted mainly from the gathered statements. Topics of Safety/Security research were extracted by means of a multi-level content analysis method.

Phase 3 – Prioritization of Safety/Security Research Topics: A process of gradual information clustering or pooling provided 99 main statements as subtopics. The subtopics were prioritized by a working group comprising participants from different research organisations, the Austrian research promotion agency and the federal ministries.

Phase 4 – Determination of Research Promotion and Funding Thresholds for Prioritized Research Topics: The same workgroup involving federal ministry representatives, the Austrian research promotion agency and experts of research organisations determined the thresholds for the minimum amount of funding resources for the prioritized safety/security research topics identified in phase 3.

Phase 5 – Proposal of an Accumulated Financial Budget Frame for an Austrian Safety/Security Research Funding Programme: Based on a European Safety/Security research programme with more than €1Billion a year and an Austrian annual financial contribution of around 2.3% to this programme, an Austrian safety/security research funding programme with an annual budget volume of more than €20Million considered necessary to promote Safety/Security research in Austria.

Social Stability & Technological Support

The underlying foresight based approach to research priority setting resulted in 35 Safety/Security research themes being discussed during 20 half-day workshops and further supplementary meetings. Moreover a further 35 Safety/Security research topics were suggested in personal interviews with experts familiar with Safety/ Security research.

To prioritize research topics of particularly importance for Austria, they were first re-grouped under eleven thematic categories. Finally these were bundled into four Safety/ Security areas for research. Labelled from A to D these are described below.

A. The Fundamentals of Safety/Security Research

It was necessary to distinguish four main aspects of fundamental research on safety/security:

- Theoretical aspects,
- Empirical questions, and
- Scenario exercises.

The theoretical aspects consider the development of political cultures in Europe, whereas the main empirical questions deal with issues such as how to 'export' economic and social stability for example to new member states with a view to preventing a political crisis. Issues to be addressed through research on Safety/Security include:

- Stability enhancing measures,
- Alternative Safety/ Security concepts,
- The protection of minorities and civil rights,
- The proper handling of asylum,
- Migration and the protection of immigrants.

Finally there is also a need to continuously update our understanding and assessments of the status quo on the basis of future scenario exercises to explicitly assess possible threats to Austria originating from both within and without Austrian society.

B. Safety/Security Related Research and Risk Analysis

The thematic category of Risk Analysis was split into four sections:

- Risk analysis concerning Terrorism and War,
- Human risk factors,
- Trust building capabilities,
- Risk analysis regarding societal development and scientific-technological progress.

Terrorism and War was identified as one of the most significant Safety/Security threats today. Non-proliferation strategies and advanced detection technologies to provide protection against atomic, biological, chemical and radiological threats represent the heart of Safety/Security research in this area.

An important risk factor which has not been given due attention until now refers to the capabilities and limits of human beings. This reveals itself especially in fields such as aviation where there could be issues of pilot reliability or in road transport where fatigue, recreational drug use or medication can impair the performance of the driver, putting them, their passengers and the public at risk. Human error is another area. Error avoidance and fault tolerance are therefore important research fields in safety research. Trust building is important to reduce this risk factor because it improves communication and enhances cooperation and collaboration of human beings.

Unemployment and the future of the welfare system are of constant concerns in modern societies. Social security, domestic peace and democracy are intimately connected to Safety/Security issues. It has to be considered that both ideologies and values can shape and destroy societies. In a societal context ethical issues and human rights are also key issues for Safety/Security research.

Safety/Security research regarding scientific-technological progress includes understanding the impact of non-intended and un-foreseeable risks and their consequences. The investigation and assessment of risks and their consequences in environmental, social and economic terms is especially important for new technology fields that have a security dimension such as converging technologies.

C. Safety/Security Research on Crisis Prevention

In prevention-of-danger research is focused on Safety/ Security building structures, as well as the detection of threats and areas that need special protection.

Education and training is an essential basis for building up Safety/Security structures. One goal of such research is to identify remaining opportunities for using education and training at all levels of human organisation – individual, family, commune, the region, state, the European Union and global society – to prevent crises, identify threats and manage risks.

The detection of threats implies the identification of threats and the downstream application of instruments for crisis prevention. Anthropogenic causes of threats can be anticipated using tools such as scenario planning and can be used to develop strategies for handling emergency cases.

The concentration of populations in urban areas, as well as the economic importance of these areas implies a high level of risk in cities. Safety/Security research on critical infrastructure, addresses issues such as the reliability, vulnerability, robustness and security of transport, energy or water supply infrastructure. This is a key theme for research on areas that require special protection.

D. Safety/Security Research Regarding Civil Defence and Crisis Management

Civil defence and crisis management depends among other things on regional structures and topography.

The optimization of strategies for coordinating non-governmental and governmental action forces at national or international level, as well as crisis management techniques and the development of emergency scenarios are crucial security research concerns.

Technological and Management Capabilities as Austrian Strengths

One of the first steps in this initiative was to survey the Austrian research landscape in the Safety/Security research and get an overview of what was being done, identify active Austrian expertise and capacities in Safety/Security research at universities and applied research organizations as well as Austrian industry and in the Austrian small and medium-sized enterprise sector.

The most relevant research organisations and industry actors in prioritized Safety/Security research topics were identified. The survey gathered data on more than 200 Austrian companies and 150 research organisations highlighting Austrian excellence and expertise in Safety/Security research. A number of areas stand out in which Austria has specific strength as well as a critical mass of research activity.

Tunnel Safety: Quite a number of Austrian small and medium sized companies are highly specialized in tunnel construction and safety.

Vehicle Design for Crisis Management: There is a steady increase in the trans-European road transport of hazardous goods. Research organisations such as ARC Seibersdorf Research Ltd are specialized in areas such as monitoring the transport of radioactive substances. Another example is the 'Via Donau' research organization that operates positioning technologies for seamless tracking and tracing of hazardous goods. Both of these possess unique expertise of considerable importance for research on road transport related Safety/Security.

The Prevention of Manmade and Natural Hazards: In response to its natural topography Austria has developed considerable experience dealing with the risk of flooding and protection against avalanches. It has developed considerable research expertise in these and related areas of research.

Relevant Fields in Humanities and Social Science: Austria has a research tradition in conflict management, crisis prevention and counter-proliferation due to its neutral status and its role as host to international organisations such as the UN and the IAEA. It also has well developed research capabilities in human rights and ethical issues as well as political integration.

The reporting team suggested drafting a national Safety/Security research funding programme that focused on some of these prioritized Safety/Security topics. A first call for proposals has been launched for research on critical infrastructure issues.

The team also recommended the establishment of a 'National Agency for Safety/Security Research and Coordination'. The role of this agency would be to develop and maintain intelligence and know-how on medium to long-term Safety/security issues, handle confidential information, prepare and carry out campaigns to increase public awareness on Safety/Security concerns and be continuously involved in the advancement of national Safety/Security strategies. Eventually this agency should provide easy access to up to date information about national capabilities in the field of Safety/Security research for members of specialists as well as for members of the general public.
They estimated that this would require a budget of about € 20 Million on an annual basis to support a programme of competitive research on Safety/Security issues as well as the running of a 'National Agency for Safety/Security Research and Coordination'.

Potential Applications of Biometric Technologies, Protective Clothing and Cryptography

There exist quite a number of highly specialized companies and applied research organizations in Austria that carry out leading edge research in technologies intended for the

Safety/Security related applications. Companies in sectors such as cybernetics or communications engineering, working with research organisations have developed a high level of expertise in applied biometrics. In other sectors such as vehicle design, construction and textiles there is a strong presence of small and medium sized companies specialised in the design of vehicles for crisis management and tunnel construction. Others are involved in the development of protective clothing.

In the tertiary sector data processing and business services related to software safety and interoperability, as well as the development of model simulations for technological failure management all have a role to play in the area of safety/ Security and should be involved in national research in this domain.

Austrian research organisations have played an important role internationally in the development of proprietary conditional access systems. For example they have developed gateway technologies using quantum cryptography or mathematical algorithms which could lead to pioneering innovations in the area of Information and Communication Technologies. Medicine and biotechnology also has a contribution to make to Safety/Security related research. There is a need to explore the consequences and risks of new technologies through techniques such as 'technology assessment' but inter-disciplinary work on the prevention of natural, chemical and biological hazards needs to be further encouraged, supported and coordinated.

Some well-known research institutes in Austria work in fields such as political integration, conflict management and crisis prevention. Although there is extensive disciplinary know-how and experience, there is limited inter-disciplinary and trans-disciplinary networking on Safety/Security related issues and no systematic coordination of efforts. An organization is required to play this role and to raise the profile of the Safety/Security research sector not only in Austria in Europe and the rest of the world.

Meeting the Public Interest

The project 'Safety/Security Research – Idea and Procedure for Austria' demonstrates the urgent need for continuous strategically coordinated Safety/Security research. There is increased public interest in Safety/Security issues at European Union level. The public authorities in Austria have a responsibility towards their own population on Safety/Security issues, as well as towards their neighbours in European Union. It is therefore important to take action without delay.

Immediate steps include the establishment of a national programme for Safety/Security related research to enable full Austrian participation in the upcoming Seventh Framework Programme of the European Union under the thematic priority for 'space and security research'.

This would help Austria to adequately respond to Safety/ Security incidents such as terror attacks, natural hazard or large-scale technical failure. Answers and solutions to Safety/ Security challenges developed in the context of a successful Austrian Safety/Security research programme will certainly be acknowledged by the public as a substantial contribution to the safety, security and well-being of its citizens.

Sources and References

http://hw.oeaw.ac.at/3469-X

Sustainable Transformation of German Utilities 2025

Authors:	Kornelia Konrad / Kornelia.Konrad@eawag.ch Jan-Peter Voß / J.Voss@oeko.de Bernhard Truffer / Bernhard.Truffer@eawag.ch
Sponsors:	The BMBF - German Federal Ministry of Education and Research
Type:	Sectoral foresight on utilities - electricity, gas, water & telecom - with a national focus on Germany
Organizer:	Öko-Institute.V., Christof Timpe – Coordinator/ C.Timpe@oeko.de The EAWAG - Eidgenössische Anstalt für Wasserversorgung, Abwasserreinigung und Gewässerschutz, Bernhard Truffer / Bernhard.Truffer@eawag.ch Forschungszentrum Jülich, Cornelia Karger / C.Karger@fz-juelich.de
Duration:	2002-2006 Budget: € 1 800 000 Time Horizon: 2025

Motivation

This project was established to explore the consequences of structural change in German utility sectors and to raise awareness of the need for coordinated action by stakeholders as well as for the development of strategies for sustainable development. A three step procedure was applied comprising socio-technical scenarios, sustainability assessment and strategies for critical innovation processes. Interactions between four utility sectors - electricity, natural gas, water and sanitation, telecommunications - were considered. Stakeholders involved in production, consumption and governance have been involved at all stages. A multi-level approach was applied to link developments at the sector level with general societal developments and the dynamics of specific fields of innovation. The project also aimed at developing a general methodology for 'sustainability foresight'.

Decentralisation, Customer Orientation and Integration of Utility Sectors

The project was set up under a research programme that supports trans-disciplinary sustainability research financed by the BMBF - German Ministry of Education and Research. It took ongoing transformation processes in the utility sectors as a starting point. Network bound infrastructures for electricity, gas, water and telecommunications undergo changes triggered by policies for market liberalisation and privatisation. Additionally, recent developments in the sectors indicate great potential for radically new technologies and for the existence of demand conditions which could fundamentally transform the way utility services are produced and consumed in modern societies. Obviously such transformations would have considerable impact on the sustainability of these utility sectors as well as on most other economic activities and patterns of consumption.

These changes are characterised by three dimensions of important for the public debate:

- Decentralisation of production,
- Stronger interaction between sectors, and
- A more central role for customers.

More generally this project addresses the challenge of governance under conditions of uncertainty due to:

- Complex interaction between social, technical and ecological processes,
- Ambivalence about sustainability goals,
- Dispersion of the authority required to command change among many independent actors.

The objective of the project was to develop strategic orientation on transformation across action domains. For this it was necessary to:

- Analyse, empirically and theoretically, transformation processes in the provision, consumption and governance of the four sectors,
- Develop socio-technical scenarios spanning a possibility space for the development of the sectors until 2025,
- Assess the scenarios according to sustainability criteria defined by stakeholders,
- Develop measures and strategies addressing specific

innovation fields for modulating transformation processes,
- Bring together stakeholders from the different sectors and different action domains - provision, consumption and governance of utility services.

Sustainability Foresight

The analysis of ongoing transformation processes was based on desktop research, expert interviews and a series of stakeholder workshops. The 'scenarios', mainly qualitative in nature, were developed in the course of a series of stakeholder workshops. The 'sustainability assessment' combined participative approaches and expert judgements. The development of 'measures and strategies', was based on desktop research and a stakeholder workshop.

Four Scenarios for the Future of German Utilities

On the basis of about 40 influence factors, four alternative future scenarios were developed. Influence factors covered processes in the provision of the utility such as the size and type of power plant, consumption factors such as geographical changes of consumption structure and regulatory factors such as environmental and energy policy.

The scenarios considered developments at the sector level as well as general societal developments such as demographic change and economic growth. They also factored in the innovation dynamics of relevant technology domains.

Scenario A: Decentralisation by Consensus
- Decentralisation of technology
- Energy mix with high percentage of gas and renewables
- Low market concentration
- High degree of service orientation
- Utility sectors tightly coupled
- State as moderator

Scenario B: Conservative-Ecological Development Path
- Mainly centralized technologies accompanied by decentralized technologies for environmental reasons
- Energy mix which has a high percentage of gas and renewables
- Active innovation policy focusing on efficiency gains for central technologies
- Low market concentration

Scenario C: Diffusion of Technology Mix by Energy Corporations
- Mainly centralized technology but decentralized technologies are used to diversify the technology portfolio
- The energy mix as a high percentage of coal and nuclear
- High market concentration (international oligopoly)
- Strong market regulation

Scenario D: No Replacement of Established Structures
- Centralized technology for energy and decentralized technology for water
- Energy mix with a high percentage coal and nuclear
- High market concentration
- Two tier class society
- Utility sectors separated
- No active innovation policy
- Weak market regulation

These scenarios delineate a space for possible future developments. This 'probability space' may be characterised as follows: The scenarios cover:

Phase	Process Steps	Actors
Adaptation to problem area	Scanning of future discourse and visions discussed in problem area and development of heuristic conceptual framework of the transformation process	Project Team
Phase I: Exploratory Scenarios	Collection of influence factors and elaboration of alternative projections, cross-impact analysis, construction of scenarios as combinations of factor projections, narrative storylines for selected scenarios	Stakeholders and Project Team
Phase II: Discursive Sustainability Assessment	Elicitation of sustainability criteria held by stakeholders	Stakeholders
	Development of impact profile of scenarios with respect to identified criteria	Experts
	Discursive assessment of risks and opportunities connected to scenarios	Stakeholders and Experts
Phase III: Shaping Innovation Processes	Identification of critical innovation fields Analysis of actor networks and context conditions of critical innovations; Sketching of paths leading to the different states of the innovation fields as they were described in the scenarios	Project Team
	Development of measures supporting a sustainable development of innovation fields; identification of potential interactions between measures which should be taken into account by an integrated strategy	Stakeholders and Project Team

The table provides an overview of the 'sustainability foresight' process:

- A broad range of possible technological and organisational strutures for the provision of utility services,
- Both a technical decentralisation for example in the form of combined heat and power plants at the district or household level or decentral sanitation and water recycling systems, and centralisation expressed in the use of large central power plants.

A fully decentralised electricity or sanitation system however is not to be expected to arise within the timeframe considered. Market concentration of utility companies may decrease or increase in the future. Technical and organisational (de) centralisation are not necessarily correlated. This may seem counter intuitive to some, but it is dealt with explicitly in the scenarios. The role of 'the customer' increases to a greater or lesser degree in all scenarios. This translates into the form of the various services offered by utilities, and may involve the contracting of appliances, package offerings, remote maintenance or demand side management. Furthermore all scenarios assume stronger interaction between the different utility sectors. Limited interaction scenarios take the form of multi-utilities, integrated customer services and network maintenance. More extensive interaction may be required however as a follow-on from technical decentralisation.

The sustainability assessment showed that no scenario excelled clearly as the most sustainable scenario. Each scenario presented its own spectrum of strengths and weaknesses from a sustainable development point of view.

Critical Fields of Innovation

In the scenario process various technical and non-technical innovation fields were identified as having a potentially important impact on the future of utility services. From these three innovation fields were chosen: combined heat and power plants at the household level (micro CHP), smart building and network regulation. These fields address the provision, consumption and regulation of utilities. They vary substantially from one scenario to another in terms of their role and importance. However it is expected that they may make a substantial contribution to the 'sustainability performance' of utilities.

Combined Heat, Smart Buildings and Network Regulation

'Micro-Cogeneration' units are small power plants which produce energy for heating what are usually large buildings and electricity, which may then be fed into the grid. It is believed that combined heat and power production provides a key to sustainable energy use. However there is a risk that indiscriminate promotion of micro CHP applications could displace competing innovations for sustainable energy generation which may in some cases be more appropriate. This may apply to cogeneration on larger scales (district heating), high building insulation standards (passive housing), or solar energy use.

'Smart Building' technologies allow for the management of utility use and consumption on the basis of communication between building technology and household appliances, from within the house and from outside. These technologies may influence energy and water consumption in buildings. They provide opportunities for efficient energy use and better resource management. On the other hand smart building may result in additional energy consumption. Networking technologies applied inside buildings and with the outside world link the provision and consumption of energy. On this basis demand side management tasks such as load management and consumption analysis are possible. Furthermore they can help to optimise the operation of micro CHP either on a local level or on the level of electricity networks.

'Network Regulation' refers to a set of institutional provisions for access to and usage of utility network infrastructure. It balances a variety of different objectives such as the stimulation of competition through non-discriminatory rules for different categories of service providers, with the need to ensure security of supply by enabling the recuperation of investment costs and appropriate load management by network operators, while at the same time preventing actors from earning monopoly rents.

The sustainable development of utility systems may require additional concerns to be taken into account. For example the construction of network structures is closely linked to anticipated patterns of generation and consumption. These must adapt if new generation technology is to be introduced in the system, based for example on renewable sources, if new technologies such as the internet change patterns of demand, or if energy saving technologies allow us to modify the impact of our consumption on the environment. Active network operators can play a central role as change agents matching new patterns of supply and demand.

Finding the Nexus between these Three Fields of Innovation

In a two-day workshop that brought together about 50 stakeholder experts from these three fields of innovation, a set of measures was developed for each of these innovation fields.

They took in a wide range of variables relating to areas such as regulation, experimentation and technical development. They tried to capture the positioning of a heterogeneous group of actors representing interests as wide ranging as those of policy makers, business or consumer associations and manufacturers. Furthermore, the interactions, possible synergies and coordination requirements were identified.

Local load management as well as network oriented load management in systems that involve micro CHPs constitute a nexus between these three innovation fields.

Establishing an Institutional Framework for Different Fields of Innovation

The transformation of utility sectors opens up a broad range of possible development paths. They each show different sustainability impacts. However no single scenario scores high on all accounts. Decentralisation appears favourable in many respects but it is not a panacea. In appraising alternative utility structures various perspectives have to be taken into account to find the optimal scale and combinations between centralized and decentralized structures for technology, organisation, and policy-making.

With respect to social and ecological issues, two different pathways can lead towards desired futures. In one of these, public policy supported by public opinion, assumes a strong lead role in guiding structural transformation. This pathway requires strong innovation policy, to address innovation in large scale environmental technologies, combined with strong regulation. The other path is characterised by a high degree of social self-organisation. This includes public discourse on technology and required service levels as well as stakeholder participation in corporate decision-making. In this case the state assumes the role of a moderator. This path is based on the appraisal of a broad range of impacts of alternative futures and on recognition of mutually interdependent groups of actors. This path would be linked to more decentralized organisational and technological structures for utility provision.

Transformation Fora

Specific measures to be undertaken by various groups of actors have been identified in the foresight process. A report summarizing these proposals will be available quite soon at www.mikrosysteme.org. The need to establish an institutional framework to accompany these measures in a continuous and systematic manner was emphasised. In particular this required to support and co-ordinate the measures and processes taking place in different fields of innovation. Until now, there are no institutional structures which support processes that lie in the nexus of different fields of innovation. This gap could be bridged by 'transformation for a' set up by the research ministry or a similar institution, to some extent modelled on the Dutch example of 'transition arenas'. These institutions would involve different stakeholder groups affecting or affected by the transformation process in a continuous process of strategic and long-term co-ordination of actions. These do not necessarily imply a common vision shared by all participants. Transformation fora may be complemented by strategic programmes of innovation support and they should carry out the following tasks:

- Coordinate measures in relevant innovation fields,
- Monitor and evaluate experience gained from experiments,
- Explore evolving relevant contexts and developments,
- Adjust strategies in the innovation fields on the basis of these experiences, interactions and developments.

Once one or multiple transformation fora are established for a certain set of innovation fields, additional fora may follow interlinked with innovation fields covered so far.

Transformation fora represent new instruments or 'nexus arrangements' for accompanying and modulating innovation field specific foresight processes as well as technology research and development aimed at ensuring the sustainable transformation of the utility sector.

Sources and References

www.mikrosysteme.org
www.sozial-oekologische-forschung.org

Japanese S+T Foresight 2035

Authors:	Kerstin Cuhls / Kerstin.Cuhls@isi.fraunhofer.de		
Sponsors:	MEXT - The Japanese Ministry of Education, Culture, Sports, Science and Technology The Science and Technology Council of Japan		
Type:	National foresight exercise		
Organizer:	NISTEP - The National Institute of Science and Technology Policy		
Contact:	Yoshihiko YOKOO and Terutaka KUWAHARA / yokoo@nistep.go.jp		
Duration:	2003-2004	Budget: € 650 000 approx.	Time Horizon: 2035

The Eighth National Japanese Science and Technology Foresight

Every five years Japan conducts a large national foresight exercise to gain new information and update insights gained from previous foresight activities. One of the most important elements of these foresight exercises is a comprehensive Delphi survey involving more than 2,200 independent experts from different disciplines. The results of this whole process serve as inputs for policy-making and provide valuable information for all interested parties including stakeholders from companies and students. In the eighth Japanese national foresight exercise a wider approach was adopted. This exercise included a study on rapidly developing technologies, scenario development and a demand-oriented study.

Method and Approach

New Foresight Instruments

Japan now has 40 years of experience applying the Delphi method to gathering intelligence for national foresight programmes on science and technology. Although the data generated from the Delphi process was used in different ways by different stakeholders and representatives from different levels of policy-making, the surveys were mainly based on science and technology 'supply' orientation. The questions framed in the Delphi surveys were not based on demand side considerations. As in other countries this approach has often been criticised for not giving due consideration to demand-side issues.

In response to this criticism of earlier Delhi surveys the instruments applied in the eighth national foresight exercise were broadened and the overall approach rested upon four main pillars:

- A survey on demand for new technologies,
- A study on rapidly developing technologies based on a bibliometric approach,
- Scenario development, and
- A comprehensive Delphi survey.

All foresight surveys conducted so far in Japan found their audience and were regarded as an input into policy-making on the one hand and general information for all interested parties, organisations and private persons on the other hand. Nevertheless it was often considered that previous Delphi surveys tended to arrive too late to serve as useful inputs for national programme development. The organisers were intent on avoiding this problem from now on.

It was therefore decided to conduct the 8th Foresight earlier than after the usual 5-year-term so that the results would be available as inputs for the new Science and Technology Basic Plan, a programme guideline for which development will start in 2006.

Preparations for the S&T Basic Plan

Prioritisation for the next Japanese Science and Technology Basic Plan requires a holistic approach to issues such as:

- The potential development and impact of science in terms of fields, areas, and even specific technologies,
- What society expects from science and technology, and
- The latest trends in basic research.

The NISTEP or National Institute of Science and Technology Policy provided its 'Science and Technology Foresight Survey' with the goal of:

- Contributing to the development of the Basic Plan for Science and Technology that would come into effect in the period 2006 to 2010, and
- Setting the corresponding priorities for investment and resource allocation.

The overall scheme aims to provide the foresight data and the results to a broad variety of decision-makers to be reflected in their policy-making.

Despite the accelerated agenda the budget for the eighth national S+T Foresight was fixed in good time. The different steps and the detailed approach to be used were discussed between the organisers and the main 'client' - the Japanese Council for Science and Technology. During this process the Council decided to add a literature data-base for the field analysis which the study about rapidly developing technologies could be based upon.

More Emphasis on Societal and Economic Demand

The new methodological approach was a combination of both well-established instruments and new instruments. The first three methods provided inputs for the fourth - the Delphi survey. The results, the priorities for Japanese S+T policy, were selected qualitatively using all tools as inputs but relying mainly upon the study pm rapidly developing technologies as well as the feedback from the Delphi survey.

1. The survey on demand looked at demand up to the year 2015 and started with an analysis of S+T needs for the future based on interviews, a survey and a workshop that also involved experts from the soft sciences and from scientific journals. A list of societal and economic need was drawn up, structured and assessed in panels using an interactive participatory approach. In a second step each topic was examined to see if it should be explicitly reflected in S+T policy and to understand the major directions in which it was likely to evolve in the future. In a third step, topics from the seventh foresight survey were analysed and corresponding level of demand formulated.

2. The study on rapidly developing technologies was based on a bibliometric approach. An analysis of article based on the Science Citation Index lead to the identification of 153 fields that were clustered in a map. This mapping technique allowed experts to reduce the list to 51 rapidly developing technology fields that were regarded as possible priority areas for future Japanese S+T research efforts.

3. A series of 48 scenarios were written by experts identified by NISTEP. These scenarios were inter-connected in the sense that there was some thematic overlap in the high priority topics that were chosen as the basis for the scenarios. They stemmed mainly from the larger clusters of life sciences, environmental sciences and frontier research domains such as space, marine and geo-science, as well as information technology and structures, production and society. These normative scenarios consisted of short one page descriptions accompanied by longer texts providing recommendations on how the scenarios as outcomes could be achieved in practice.

4. A comprehensive Delphi survey was conducted in two rounds with feedback in the second round. Topics formulated in short statements were derived from the other three approaches and worked out in detail in expert working groups. Classical feedback focused on issues such as the importance of the topic, the time to realisation, the leading country in the field and recommendations on measures to be taken now.

Participation in the first three activities was limited to the number of persons in the different panels and workshops. Nevertheless a few hundred participants from different backgrounds were involved. Already in the preparation of the topics for the 13 Delphi fields, more than 200 experts from industry, academia, research institutions, associations and others were asked to participate in workshops and panels or to help clarify issues on a bilateral basis. In the first round of the survey 4,219 questionnaires were sent out and 2,659 experts replied. In the second round 2,239 were sent out and the response rate was 84%.

The different instruments produced a huge amount of data and required a very high level of communication among stakeholders. The results were published in a series of four reports, in a variety of different formats.

An Overview of Results

The 'hot topic' emerging from the fifth Delphi survey was the environment, whereas that emerging from the sixth was IT security. Looking through all four reports of the eighth S+T Foresight exercise three major trends can be observed:

- Technologies concerning safety and security,
- Topics concerning human resources,
- Interdisciplinary or fusion fields in S+T are now developing quite rapidly.

Demand for S+T to Help Improve Daily Life

The overall results from the survey on demand were very general and not very astonishing. For daily life, necessary needs like a stable job, securing food, the use of energy, safety and security, but also love and communication, including welfare for underprivileged people and a good education, or respect and dignity were among the most important demands of the study. These and other desires provided important background information for the subsequent studies dealing with science and technology.

Priorities for Rapidly Developing Technologies

The bibliometric study identified 153 technologies, of which 51 are regarded as very important for Japan. About half of these are expected to be directly prioritised in the Basic Plan. The classification started from the traditional disciplines, although important topics often occur at the borders of the classical disciplines and have an interdisciplinary nature. These topics can be analyzed into clusters as follows:
Clinical Medicine: Studies on telomerase, hormone therapy, immune disease research, viral hepatitis, glutamine receptors, stem cell regeneration, the impact of air pollution particles on the health of human beings and others.
Plant and Animal Science: Cell membrane channels, study of the biological clock, molecular biotechnology, influenza etc.
Chemistry: Proteomics, ionic liquids, enzyme and complex catalysis, carbon-carbon bond formation reaction, etc.
Space Science: Origin and mechanism of the universe, mesoporous materials and nano-wires.
Physics: Neutrinos, new metallic superconductors and heavy-fermion superconductor, high temperature super conductors.
Social Science and Economics: Schizophrenia, decision-making and governance based on behaviourism, community development and networks under globalisation, IT-based organisational management and knowledge management. etc.
Geoscience: Paleo-climatic research, global-scale oceanic climate change research.

The 48 Scenarios

The 48 scenarios consisted of short 'pictures of the future' on specific themes referring to different disciplines and interdisciplinary issues. Well-known experts from the fields recommended strategies to realise objectives formulated in the scenarios. The scenarios represented a mixture of demand-oriented and S+T push approaches to envisioning the future. Push approaches for example had to do with mathematical research and development as well as education, the space sciences, ideas for the application of nano-biotechnology, new medicine for the needs of individual people, changes in the structures of medicine and therapies, humanoid technology, low emission cities, saving energy, satellite technology, food safety, prediction techniques for economic changes or science and technology for arts, culture and entertainment, etc.

The Results of the Delphi Survey

The Delphi survey was conducted in fields which could already be regarded as priorities. These included fields such as Information and Communication, Electronics, Life Sciences, Health, Medicine and Welfare or The Environment. New entrants were areas such as 'Nanotechnology' or 'Nanotechnology and Materials. Classical fields such as 'Management and Production' field were split into 'Organisation' and 'Basics of Production'. These covered areas such as logistics, management and administration. More emphasis was placed on societal issues than in the past. Former fields such as transport and architecture have now been integrated into the more holistic notion of the 'Societal Base'. This covers issues relating to city construction, architecture and traffic. 'Society and Technology' now covers issues such as education, school education and public services.

The most important single topics and strategies to realise scenarios as outcomes were described in detail by Japanese experts. It is not surprising that currently the most important topics related to human life, information, the environment, disasters and energy as follows:
Human life: Topics about cancer were very often rated as important. The same was true for illnesses resulting from the ageing society like Alzheimer. But also treatments for infectious diseases and allergies were becoming more important. **Harmful chemicals:** In particular their impact on human health was also regarded as a relevant problem.
Information: The most important topics here were centred on process technologies for high efficient Large Scale Integration and wearable equipment, also topics about security in networks and viruses were especially relevant.
Environment: Topics about gases like CO_2 and NOx as well as topics about a «recycling society» got high ratings.
Disasters: Half of the high relevance topics concerned earthquakes and countermeasures to decrease the numbers of victims by prediction and the use of simulation.
Energy: The importance of topics concerning production processes with non-fossil energy sources, fuel cells for transport means and solar cells increased.

Time Horizon of Realisation

Most topics with an estimated early realisation time stemmed from the field of 'Society and Technology'. The earliest 10 were only one from each: Environment, Manufacturing, and Energy. The short term achievable scenarios had to do with e-government services via internet, clean water technologies, e-books with multimedia support, intelligent traffic systems, systems for providing emergency housing in case of a disaster, room environment control systems for safety, security and health to name a few.

The more ambitious long term goals related to energy topics such as the fusion reactor, solar cell systems for use in space and innovative treatment of nuclear waste. It has been the pattern in previous Delphi surveys to announce such goals and postpone the estimated time to realisation.

Impact of the Exercise

The eighth Japanese S+T Foresight exercise relied as in the past on the use of the Delphi method, but adopted its approach to take into consideration demand side elements of society and the economy. It is still too early to evaluate the impact that this has had. Nevertheless a general impact can already be observed.

Important Contribution to National S&T Policy: The previous foresight or forecast surveys in Japan were mainly performed to gather information about the future and distribute it to all interested stakeholders. This had an impact but the impact was dispersed and hard to measure. Until now it was not possible to demonstrate a direct link to the policy-making processes and its contribution to policy and decision-making was indirect. This time however there was an exchange of opinion with policy and decision-makers from the very beginning. The CSTP or Council for Science and Technology Policy as well as MEXT - the Ministry of Education, Culture, Sports, Science and Technology were directly involved in the process. On this occasion as well the timing of the preliminary and final report was right was much better allowing time for the relevant bodies to use the results of the exercise as inputs for their respective policy processes.

Major Impact on the S&T Basic Plan: The major impact therefore is the direct impact that this work will have on the third Japanese Basic Plan. Until now there have only been two Basic Plans for S+T as a framework for Japanese S+T policy. The Basic Plans are not fixed plans as in socialist countries. They provide the general orientation for policy-making and set the priorities in science and technology fields. It is therefore regarded as an important indicator of success if fields prioritised through the foresight process are selected by the CSTP for inclusion in the next Basic Plan for S+T.

Identified Priorities and Focus for Action: In every thematic field mentioned above, individual topics of importance were identified. They can be used both as a basis for further basis analysis or as priorities for future research. In each field a development strategy was formulated. The formulation of the text of the Basic Plan was also influenced by the results of the exercise. The thematic fields addressed in the Delphi survey and the rapidly developing technologies can be regarded as candidates for special support in terms of financing and improved framework conditions. These will be fields for national investment and can be considered as recommended fields for industrial investment as well. The government will try to improve framework conditions in these fields even if no direct investment is made by the public sector.

Key Players in Shaping the Future: The key players in shaping the Japanese future in S&T fields were directly involved in the surveys. Especially well-known scientists were asked to formulate specific chapters of the Delphi report. Persons from different backgrounds, from policy, industry and academia were included in expert groups, took part in the surveys and were nominated to write the scenarios. These are regarded as 'multipliers' in the process. On the one hand they bring in their own knowledge and on the other hand they profit from the results obtained. The single items and topics emerging fro this work that are directly included in the Basic Plan will be known when the new Basic Plan is available for the public.

Sources and References

Four reports in Japanese language have been published by NISTEP - The National Institute of Science and Technology Policy and MEXT – The Science and Technology Foresight Center, Ministry of Education, Culture, Sports, Science and Technology. These are available at **www.nistep.go.jp** and English translations will be published in 2006:

- Kagakugijutsu no chûchôki hatten ni kakawaru fukanteki yosoku chôsa (The 8th Science and Technology Foresight Survey, Needs Survey) Report no. 94, Tôkyô: NISTEP
- Kyûsoku ni hattenshitsutsu aru kenkyû ryûiki chôsa (The 8th Science and Technology Foresight Survey – Study on Rapidly-developing Research Area) Report no. 95, Tôkyô: NISTEP
- Kagakugijutsu no chûchôki hatten ni kakawaru fukanteki yosoku chôsa (The 8th Science and Technology Foresight Survey – Scenarios) Report no. 96, Tôkyô: NISTEP
- Kagakugijutsu no chûchôki hatten ni kakawaru fukanteki yosoku chôsa (The 8th Science and Technology Foresight Survey – Future Science and Technology in Japan, Delphi Report) Report no. 97, Tôkyô: NISTEP

Korea 2030

Authors:	Byeongwon Park, Ph. D. - Team Leader / Email: bpark@kistep.re.kr Foresight and Strategy Planning Team KISTEP, the Korean Institute of S&T Evaluation and Planning, Seoul, The Republic of Korea Dominik Schlossstein / Email: dominik@stepi.re.kr STEPI – The Science and Technology Policy Research Institute, Seoul, The Republic of Korea		
Sponsors:	MOST – The Ministry of Science and Technology of the Republic of Korea		
Type:	National Foresight Exercise covering scientific and socioeconomic fields		
Organizer:	MOST - Ministry of Science and Technology Korean Institute for S&T Evaluation and Planning / www.kistep.re.kr		
Duration:	June 2003-Dec 2004	Budget: € 50 000	Time Horizon: 2005-2030

The Third Korean National Foresight Exercise

The Third Korean Foresight Exercise entitled 'Future Perspectives and Technology Foresight for Korea – Identifying Challenges and Opportunities for Korea's Economy and Society' represents the most comprehensive effort to date by the Korean government in the field of S&T foresight. Capitalizing on previous studies conducted in 1994 and 1999 its chief purpose is to chart the future of Korean society and technology and link peoples future needs to innovations in science and in research. Systemic in both character and methodology this Third Korean Foresight Exercise accelerates Korea's evolution towards a knowledge society.

A Leap into the Past

Over the past four decades Korea has gone through distinctive phases in science and technology policy making, starting with the creation of MOST, The Ministry of Science and Technology and the Science and Technology Promotion Law in 1967.

With this basic infrastructure in place the 1970s can be construed as the growth stage of Korean S&T when the focus shifting to capital and technology intensive industries, heavy and chemical industries and the education of qualified scientists and engineers was emphasized at national level.

The 1982 and 1992 National R&D Plans, devised under the central theme of 'select and concentrate', have guided Korea's S&T policies and programs. Major industries of the 1980s in Korea included semiconductors, steel, automobiles and shipbuilding. By the 1990s S&T activity on the government and private levels were greatly expanded as evidenced by the fact that 75% of Korea's cumulative R&D investment was allocated past 1990. Today 75% of R&D investment originates from private sources with government contributing 25%. Total R&D investment (GERD) peaked at 22.2 trillion Korean Won in 2004 ($22 billion or 2.86% of GDP), the highest figure the country has seen since statistics were first compiled in the early 1960s.

Korea's S&T Challenges Today

Today, the Korean government is faced with the task of setting priorities in the development of a domestic technological capability and finding ways of launching new high-tech industries that can contribute to world-level competitiveness beyond Korea's traditional strengths in semi-conductors, mobile communications, petrochemicals, shipbuilding and automobiles.

Foresight is regarded as a critical tool for policy-making. While increasing the percentage of R&D funds in the government budget by double digit figures since 2001 ($4.9 billion in 2004), the government has introduced sweeping reforms to its national innovation system, most notably a large-scale reform of the MOST in 2004.

This reform essentially converted a division of the MOST into a secretariat to the NSTC - National Science and Technology Council and elevated the Minister of Science and Technology to the position of Deputy Prime Minister. According to the OECD this was the first such upgrade in the world according to the OECD.

Combining Business and Basic Research

Most government attention is now focused on how best to complement business R&D through the provision of basic research and the crafting of an efficient institutional framework in which different S&T actors collaborate, share knowledge and provide educational opportunities for young scientists. Against this backdrop, and in conformance with Article 13 of the Science and Technology Basic Law of 1999, the Third National Foresight Exercise pursued goals:

- To define strengths and weaknesses of Korean S&T across a range of industrial sectors up to the year 2030, and provide a basis for international benchmarking,
- To identify future societal needs in the broadest sense of the word, matching them to specific technologies that are deemed appropriate to fulfill these needs,
- To assess the attributes of each future technology such as realization time, technology level of Korea compared with other countries, and possible obstacles to be overcome from the viewpoint of policy makers,
- To create forward-looking scenarios as a basis for priority setting in national R&D projects and to provide guidance for private-sector R&D decision-making,
- To foster a broader debate about desirable pathways of S&T in the general public and provide a forum for experts, policy-makers as well as representatives from business and civil society to dialogue about the future.

Methodology: A Mix of Survey Techniques

Reflecting these multi-faceted study objectives, an interactive sophisticated amalgamation of on- and off-line survey techniques was adopted. The overall process is in many ways comparable to the Eighth Japanese Foresight Exercise. In total the Third National Foresight Exercise lasted from June 2003 until December 2004 and was published in an unprecedented public relations drive in May 2005. The areas of consideration were:

- Space & Earth,
- Material & Manufacturing,
- Information & Knowledge,
- Food & Bio-resources,
- Living & Health,
- Energy & the Environment,
- Safety,
- Infra-technology,
- Management & Innovation, as well as
- S&T for Society and Culture.

The exercise consisted of three distinct phases:

- The first phase, from July to December 2003, brought together a distinguished panel of experts from diverse academic fields to **identify future prospects and needs** of Korean society grouped under four called ‘actors’:
    - The World,
    - The Nation,
    - Society, and
    - The Individual.
- This effort was supported by a separate survey of 1,000 experts and 1,000 members of the general public. As an additional Delphi study, an internet-based questionnaire was sent out from January to July 2004 to 32,411 experts in Korea in the first round, all of whom are Ph.D. degree holders. 16.7% of them (5,414) replied in the first, and 61.4% (3,322 out of 5,414) in the second. The experts answered on average 40-50 questions in one or two of the eight overall fields of technology. In total, the survey entailed 761 subjects grouped in subcategories each consisting of about 20 questions.
- In the third phase during the second half of 2004, **scenario panels** put together and visualized likely scenarios for Korea in the fields of education, labor, health services and safety systems. In addition, cartoons, comic and science books, posters, chronicles of future technology and a short movie were produced to helped spread a foresight culture in Korea.

Societal Issues

The Aging Population

The current Foresight exercise has assessed various aspects of global challenges that the country will face inevitably and will have to deal with in the future. For example, the rapid process of demographic transition in Korea has brought about an increase of both the absolute number and the proportion of the elderly in recent years. The proportion of people aged 65 stood at only 3.3 percent in 1966. However it increased to 9.1 percent in 2005 and is projected to increase to 24.3 percent in 2030. The aging speed of the Korean population is apparently faster than that of developed countries. Korea, which has already experienced large declines in fertility and mortality, has a tremendous momentum for further population aging. In 2005, the fertility rate is about 1.2. If this situation persists, it would eventually cause a decline in the population size (overall and of working age) presenting various socioeconomic challenges to pension and healthcare services, in particular.

The Lack of Natural Resources

In terms of energy, Korea has no domestic oil reserves. Oil makes up for the largest share of Korea’s total energy consumption accounting for 54 percent of Korea’s primary energy consumption in 2002. Korea is the 7th largest oil consumer and 5th largest net oil importer in the world. Unfortunately this trend will not change very much in coming years.

Responding to Public Needs

Science and Technology policy in Korea, usually devised in a top-down and government driven way, has been quite successful until now. Recently however stakeholders increasingly demand that Science and Technology should respond more directly to public needs. Unfortunately it is not straightforward to connect societal needs to science and technology domains that provide some solutions and only then in indirect ways.

In the first phase of this exercise the four actor groups were selected to reflect relevant viewpoints – that of the individual, the society, the nation and world. These explored 15 main themes and 43 sub- themes. The following diagram provides an example of how the theme of health and living was addressed from the point of view of one of the actors in this case the individual.

Individual- Health and living	
Sub-Theme	**Detail**
Dealing with desease	The prevention Diagnosis and treatment of: • Hard to sure diseases • Geriatric diseases • Chronic diseases • Contagious diseases • Artificial Organs • Applied Biotechnology
Quality Health Service	High quality health care systems • Alternative medicines • Secondary infection in hospitals
Health in Normal Living	• Convenient normal life • Health Maintenance System
Safe Food and Products	• Safer Food Products • Safer Products • Environmentally friendly food and products

Assessing the Time Horizon

Having identified future topics for Korean S&T policy the Delphi exercise served to assess the time horizon of each technological development. This second phase task revealed that in most cases the 'realization time' was distributed around the year 2015 even though the sectoral panels were asked to put forward technologies that might not be realized until 2030. Such observations have been made in many Delphi surveys, for example in those conducted in the UK, Germany and Japan. Delphi surveys are often biased by optimism due to expert involvement and the tendency of experts to underestimate realization and diffusion problems.

Most of the technology subjects in the field of 'information and knowledge' will be realized around 2010 though some from 'Space and Earth' will be realized later than 2025.

Competitiveness of the ICT Sector

The R&D level of Korea was compared to the technology world leader in the Delphi survey. By comparing Korean status of a field with that of the leader in the field, it was demonstrated that Korea lags far behind the leaders in important areas of future technology. The R&D level of 'Space & Earth' sector is the lowest and that for 'Information & Knowledge' is the highest reflecting the characteristics of Korea's current economic competitiveness. Semiconductors, TFT-LCD, digital TV, mobile phones and internet games are domains where Korea enjoys a competitive edge and so ICT is an area where Korea is one of the most advanced countries in the world. By contrast however the field of 'Space and Earth' really relies on 'big science' and according to the results of the Delphi survey Korea has not yet established a firm technological base in related industries. Overall these results sent a warning signal to the Korean government saying that the future competitiveness of the country is at stake. According to many Korean experts the government should take measures allocating resources to strengthen R&D capability in the area of basic science that will enable it to catch up with advanced countries.

Scenario Building for Future Social System

2004 marked the first time in Korean foresight history that scenario development was tried out. Four subject areas were chosen to develop and visualize future systemic changes - education, labour, health service and safety. The scenario panels consisted of experts with various backgrounds. For example the health service panel consisted of an IT specialist and a biochemist, health economists and a population scientist. Their work mainly focused on changes to the health service system change due to a convergence of ICT and biotechnology. The education panel was supported by a group of undergraduate students who contributed through an idea-contest. The students were asked to choose one or two future technologies that might have the greatest impact on systemic change in education and develop scenarios. The findings of the three phases resulted in the formulation of strategic initiatives.

Strategic Initiatives

By the time of the 3rd Korean Delphi study, a 'foresight culture' had already developed in the S&T community. The MOST quickly translated the findings into a strategic plan that referred to '21 future technology areas' and vowed to allocate resources. These technologies are intended to complement the 'Next Generation Engines of Economic Growth' program which was unveiled in 2003. As most of these technologies will be domestically realized before 2010 an extended perspective was called for to prioritize technologies that would start to emerge in the period 2010-2015.

As a further step three databases of technology subjects were developed and used. Out of a total of 761 technologies 189 were selected as priorities by the Priority Setting Committee. The database was complemented with new and emerging technology domains where other countries have demonstrated an interest in making investments. Two major Korean companies provided their own perspectives with a view to aligning the government R&D agenda with that of the corporate sector.

Finally 21 technology areas were selected based on their expected impact on quality of life, economic growth and public need. These are:

- Biotechnology-based New Materials and Medicine
- Biodiversity & Natural Resource Conservation
- Biosafety & Defense Technology
- Clean and Renewable Energy
- Climate and Weather Forecasting
- Cognitive Science and Humanoid Robot Technology
- Culture Content Technology for Immersive Entertainment
- Digital Convergence Technology for Augmented Reality
- Drug Discovery, Diagnostics and Personalized Medicine
- Global Observation and National Resource Utilization
- Hazard Disaster Forecast & Management Technology
- Knowledge and Information Security
- Marine Territory Management Technology
- Nano and Functional Material Technology
- Next Generation Nuclear Energy and Safety Technology
- Regenerative Medicine Technology
- Satellite Technology
- Smart Computing for Ultra-high Performance
- Super Efficient Transportation & Management
- Thermonuclear Fusion Technology
- Ubiquitous Civil Infrastructure Management

The Korean government plans to devise a master plan for a relevant R&D program in 2006.

Foresight as a Strategic Instrument for Public Policy

According to the Korean S&T basic law, the foresight exercise is envisaged to be carried out every five years. However, KISTEP and MOST have decided to run foresight exercises every year based on specific and urgent issues.

National foresight studies cutting across the broad field of science and technology will continue to be performed every five years. Another promising sign is that each of the ministries has started to run its own foresight projects.

The next step might entail the establishment of a foresight network in Korea. Additionally, there is momentum to establish a 'strategic futures unit' inside government to face unforeseen future developments.

Sources and References

The Final Report is entitled 'The Future Perspectives and Technology Foresight of Korea. Challenges and Opportunities' It was published in Korean language in May 2005 by MOST and KISTEP.

MOST - Ministry of Science and Technology is at **www.most.go.kr**

KISTEP - The Korean Institute for S&T Evaluation and Planning is at **www.kistep.re.kr**

STEPI - The Science and Technology Policy Institute is at **www.stepi.re.kr**

The Korean National Statistical Office has a website with an English language section and contains man statistics on S&T issues at **www.nso.go.kr**

New Zealand Futurewatch 2025

Authors:	Sami Mahroum / sami.mahroum@arcs.ac.at		
Sponsors:	The Government of New Zealand		
Type:	National foresight on scanning for new and emerging science and technologies, particularly biotechnologies that have implications for New Zealand's economy, environment or society		
Organizer:	The Ministry of Research, Science, and Technology.		
Duration:	Ongoing	Budget: € 350 000 (estimate)	Time Horizon: Until 2025

Goals and Objectives

The goal of this initiative is to alert the government to new scientific knowledge and technology and understand the opportunities and risks that they present for New Zealand. The ambition is to find things that are new or unusual that may act as signposts to important changes on the horizon. Another aim is to think about the impacts of new science and technology in a way that include a range of perspectives in particular perspectives from outside the world of science and technology. This is intended to improve the Government's ability to anticipate and respond to new science and technologies from a context of broad reflection on New Zealand's future.

What Biotech can do for New Zealand

The 2000–2001 Royal Commission on Genetic Modification recommended that New Zealand develop a capability for what they called 'Biotechnology Futurewatch'. This was agreed by government through the New Zealand Biotechnology Strategy. This strategy includes the following statement:

'Futurewatch activities scan, analyse and disseminate information on emerging developments to provide early alerts of new opportunities and issues. There is a need to strengthen futurewatch capacity to enable better and earlier identification of emerging biotechnologies that should be discussed by New Zealanders [...] It will also provide the means to help improve the Government's capability to respond to new biotechnologies in the New Zealand context.'

The first result of 'Futurewatch' is a report on global trends in biotechnology entitled 'Biotechnologies to 2025'. The conclusion of this report are summarised in the sections below. This activity however, links in with a range of other future-works across the government of New Zealand, and with the work of agencies and departments carrying out scanning activities.

The report was developed by a mix of people that included experts in global science trends, S&T policy advisers and futurist consultants. For the Science Discovery Scan (Chapter 9 of the report), a panel of scientists was convened by the Royal Society of New Zealand to identify major science trends based on their expert knowledge. A peer review process was used to check overall coherence and technical accuracy. A fold-out poster for dissemination was developed and tested in a work shop with policy advisers.

A Future of Converging Technologies

The 'Biotechnologies to 2025' report on the future of the biotechnology sector takes as a starting point that the future of the industry looks very different from today. Today, most biotechnology research and related business is focused, ultimately, on health- and wellbeing related knowledge and applications. The development of the sector however will be driven by two main forces:

- Technology convergence, and
- Market applications.

Both synergy and convergence between technology platforms in the biotechnology industry are on the increase. For example the personalization of treatment through genomic medicine is forecast to be mirrored in developments in food and nutrition through advances in nutria-genomics. One area of growing importance is 'diagnostic technologies' such as DNA chips and bio-sensing devices. These are developing rapidly with applications across genomic medicine, nutria-genomics, food safety, environmental monitoring and bio-defense.

Increased investment in bio-defense technology is another driver of convergence. It will inevitably drive adoption across industry sectors and lead to technology spill-over into civilian use.

Main Results of the Report

'Biotechnologies to 2025' has identified important areas for technology development that will shape the biotech sector in the period leading up to 2025. Additionally it has identified influential market developments. We first take a look at the technology development areas and then we look at market applications.

Emerging Areas of Development

Health and Wellbeing – From Repair to Regeneration: The development of regenerative medicine that is accompanying a growing understanding of stem cells and the neurological system signals a shift from an emphasis on the replacement of tissues to a more biologically based method for the repair and regeneration of tissues.

Primary Production – From High-Volume Low-Value' to 'Low-Volume, High-Value' primary production: Primary industry products have traditionally been characterized by the production of high volumes for relatively low returns. Biotechnology is enabling a move towards more value added products being produced in the primary industries (for example, pharmaceutical proteins produced in livestock and plants).

Industry and Environment – From Non-Renewable Commodity Products To Renewables: The finite nature of fossil fuels, and oil shocks – coupled with advances in industrial biotechnology, both in the development of cost-effective technologies to convert biomass to its constituent parts and in the growth in scale of bio-processing capability – are driving a trend towards the increased production of commodity products (bio-fuels and bio-plastics) from renewable biomass, such as crops and trees.

The fourth important area of development is **'Security and Defense'.**

The developments in these four areas will open up new possibilities, produce demand for new solutions, and bring about entirely new markets based on new applications. Now we take a closer look at the potential application areas identified by 'Biotechnologies to 2025'.

Health and Wellbeing

DNA chips: DNA chips and genetic testing will become integrated into standard clinical practice as the genetic nature of more complex diseases is unraveled and diagnostic tools become cheaper. This has been forecast to occur in around 2012.

RNA interference (RNAi): The therapeutic application of gene silencing could theoretically be applied to any disease that is linked to an overactive gene or genes. The first filing of an investigational drug application based on RNAi technology occurred in August 2004. The earliest prediction for an RNAi drug to reach the market is around 2019.

Stem Cell Therapies: Stem cells are the cells 'most likely' to enable anticipated tissue engineering applications due to their innate ability to differentiate into other forms of tissue. The emergence of stem cell based therapies for the treatment of chronic diseases such as diabetes, Parkinson's and Alzheimer's and heart disease are forecast to emerge sometime between 2015 and 2025.

Neuro-prosthetics: Neuro-prosthetics use brain signals to operate devices such as artificial limbs or computer keyboards. It is also possible that wearers may regain the sense of touch with the use of such devices. Successes in the lab indicate that they may be available on the market soon after 2010.

Embryo Screening for Multiple Genetic Traits: Recent improvements to DNA amplification techniques mean that doctors will be able to screen pre-implantation embryos for multiple genetic traits.

Primary Production

GM Crops - Stacked Traits: The ability to genetically modify plants with multiple genetic traits is known as 'trait stacking'. GM crops with multiple genetic improvements will enable in the first instance, greater control over production traits, such as pest resistance.

More complex transformations will follow, targeting for example 'output traits' in plants such as increased yield of oils or sugars. Artificial chromosome technology and chloroplast transformation are the two most promising technologies for achieving controlled 'stacked trait' transformations.

Marker–Assisted Selection: Breeding technologies for both plants and animals based on marker-assisted selection is likely to allow controlled, increasingly complex genetic traits in animal and plant reproduction, without the need for genetic modification.

Bio-pharming: The production of high-value proteins using plants or animals as bioreactors or 'factories' is forecast to occur between 2007 and 2020. An important market could be the pharmaceutical industry. The application of bio-pharming based on farm animals is expected to happen before it becomes possible using plants.

Industry and Environment

Bio-processing Technologies: Micro-organism- and enzyme-catalyzed industrial processing is being transformed by emerging techniques such as metabolic engineering. These techniques manipulate microbial cells to bypass cell processes in larger organisms.

Renewable Bio-Plastics: It is estimated that by 2010 10% of the global plastics market will be renewable and that sometime in the period 2020 to 2025 this will have expanded to 20% of the market.

Security and Defense

Diagnostics: National security needs are driving the development of live cell bio-sensing technologies and real-time lab-on-a-chip processing capabilities. This is particularly true in the United States. These technologies are anticipated to have spin-offs into civilian markets.

Antiviral Therapeutics: The development of antiviral therapeutics is being driven by bio-defense requirements as well as the emergence of diseases such as SARS and the Avian Flu. Approaches include targeting 'commonalities' between different viruses and attempting to counter viral pathogens in a generic way.

Observations on the Future

Are we at a Fork in the Road?

Sometime between 2008 and 2013 it is likely that there will emerge two key technological approaches for producing crop varieties with desirable complex and controlled output traits, such as enhanced nutritional value or drought resistance:

- Genetic modification,
- 'Smart Breeding' techniques based on marker-assisted selection technologies.

Given the known uncertainty in consumer acceptance of GM technologies this highlights the possibility of a 'fork in the road' where different markets by region, by sector or both, may choose one production path over the other. This situation could have a follow-on effect on the rate of development in related biotechnology market segments.

Interdependencies: Synergy or Conflict?

Forecasts for the development of bioenergy, biofuels and commodity bio-based chemicals depend to a large extent on the assumption that forecasted future developments in GM crop applications will provide improved raw materials and crop yields to act as feedstock to fuel industry growth. If markets choose not to go down the GM road then there is a possibility that the large-scale development of bio-based industry may not occur as anticipated.

The possible development of a bioenergy sector based on GM crops will almost certainly create tension between different environmental values and goals. On the one hand the development of a bioenergy sector that contributes a sustainable energy resource is environmentally desirable. On the other hand if this outcome depends on the use of GM crop technologies to achieve increased crop yields and scale, it may present difficulties for those who consider GM technologies to be in conflict with environmental outcomes.

Regulatory Readiness: Are we Future-Proofed?

Anticipating emergent biotechnologies reveals a number of technologies for which New Zealand's legislative system may not yet be adequately prepared. The report 'Biotechnologies to 2025' identified a number of areas that may warrant further exploration. These include:

- Genetic testing, and developments in genomic medicine which raise issues related to ethics and privacy as well as particular cultural issues for Maori,
- Neuro-prosthetics such as mind-controlled artificial limbs. These raise issues related to ethics and safety,
- Bio-prospecting, and the need to ensure adequate protection of our native flora and fauna while also enabling opportunities for innovation,
- Nano-biotechnology applications which may raise issues related to health, safety, ethics and privacy.

The Emergence of a 'Possibility Space': Are we moving from Therapy to Enhancement?

The convergence of technologies emerging from different market sectors can enable totally novel outcomes. 'Biotechnologies to 2025' refers to what it calls 'possibility spaces'. For example it indicates that a possibility space may open up around 2020 if there are:

- Incremental improvements in embryo screening and selection,
- Significant advances in gene therapy applications; and
- Meaningful results from the number of large-scale population-based national studies into the genetic and environmental determinants of disease.

The convergence of these three factors could enable a scenario whereby embryos could potentially be engineered to exhibit selected desirable genetic traits and lead to the creation of so-called 'designer babies'.

Readying for Uncertainty

This work has highlighted many areas in which technological development is almost certain. It has shown where research is currently focused. It has made it possible to anticipate incremental developments in knowledge and application, and to plan accordingly.

A more important aim of this futures work however is readying for **UNCERTAINTY** rather than certainty. For instance it has brought into focus areas of uncertainty such as:

- Whether and how social values and views about biotechnology may change, and
- If and when New Zealand may experience a serious national-level bio-related incident, such as an influenza pandemic or a foot and mouth incursion.

These and other uncertainties underline the need to be alert to science and technology developments and their surprises, as well as the need for flexibility to adapt in order to manage issues and take advantage of opportunities.

In this respect the New Zealand government has set up two initiatives following up on 'Future Watch':

- The Navigator Network and
- The Oxygen Group.

The Navigator Network

The Navigator Network is a scanning network. It supports a continuous scanning process carried out by contributors and users of scanning information. This approach is to be contrasted with the 'snapshot' approach adopted for the 'Biotechnologies to 2025' report.

Probably the most characteristic feature of this approach is that it recognizes scanning as a social process, involving people from a range of organisations and perspectives, the exchange of their knowledge and the development of new meaning. Another feature of the approach is its location. It is not located within any one organization but consists of a horizontal network spanning a range of government departments as well as the interface to the New Zealand national science system and its connections with global science. The initial focus of the Navigator Network is on food and agro-bio-technology, although the scanning will cover many other areas as well.

The Oxygen Group

The Oxygen Group is a unique initiative which taps into the voices and experience of younger scientists on new and emerging developments in science to provoke and inspire action toward a better future for New Zealand science. The role of the group is to advise the government on:

- Emerging science and technology trends,
- How these trends might impact on the future of science in New Zealand, and on
- How younger scientists can be more actively engaged in mapping the future of science in New Zealand and take a more active ownership and leadership of future science directions.

The members of the group come from a wide range of scientific disciplines including the biosciences and social science, the information technology or IT sector, the chemical and physical sciences, the geosciences as well as Mātauranga Māori or Māori knowledge.

Sources and References

- Biotechnologies to 2025: A report prepared for the NZ Ministry of Research, Science & Technology. January 2005.
- The Ministry of Research, Science & Technology: www.morst.govt.nz.
- Contact person: Ms. Katherine Silvester, Principal Adviser at the Ministry of Research, Science and Technology in NZ.
- The website of the Navigator Network can be found at www.navigatornetwork.net.nz.

The Polish Foresight Pilot – Health and Living 2013

Authors:	Maria Łepeta, The Polish Ministry of Education and Science / maria.lepeta@mnii.gov.pl		
Sponsors:	Ministry of Science and Information Society Technologies		
Type:	A National foresight on health and life-science research		
Organizer:	Ministry of Science and Information Society Technologies		
Duration:	2004-2005	Budget: € 190 000	Time Horizon: 2013

Purpose

This pilot Foresight project in the area of Health and Living was aimed at speeding up the process of predicting development paths that would lead to improvement in the health and quality of life of Polish citizens. This activity provides a basis for determining the paths of science and technology policies that support economic priorities and for building broad consensus on complex social issues. The 'Health and Living' area was selected for analysis due to the widespread perception that the biological and medical sciences develop very fast nowadays and this pace of change poses new challenges for policy makers across a range of domains.

Public Support for Foresight on Health and Living

The Foresight Programme was initiated by the Minister of Science and Information Society Technologies. It was part of a list of tasks intended to support innovation laid out in a national policy document entitled 'The Plan for Pro-Growth Efforts for the Years 2003-2004'. This plan was adopted by the Council of Ministers on 1 July 2003 and launched in the fourth quarter of 2003. The Pilot Foresight activity – 'Health and Living' was funded by the Ministry of Science and Information Society Technologies.

The Foresight Programme was developed on the basis of discussions with various actors who provided advice on issues such as the time, extent and methodology to be adopted. It was financed by the PHARE SCI-TECH II programme to support the restructuring of research organisations and improve technology transfer in the new member states.

A variety of case studies were analyzed in preparation for the development of the pilot foresight programme. In particular technology foresight exercises conducted in Ireland, Great Britain, Germany and Australia were examined. Finally it was decided to focus the efforts of the programme on the following fields:

- Health and Living,
- Sustainable Development,
- ICT Technologies,
- Safety.

The field of 'Health and Living' was chosen as the topic for the pilot phase. This choice was dictated by the high level of public support for the subject. Interest in these issues has been stimulated by:

- Changes in the demographic structure of Polish society in particular the challenges posed by an ageing society.
- Polish traditions of producing clean food and by.
- Attempts to find niches for Polish enterprise in the areas of medicines and pharmaceutical products.

Moreover the area of 'Health and Living' is one in which various theoretical and applied fields and disciplines of science converge. It covers issues related to the process of the aging of the population, the prevention and treatment of various diseases, new drugs, transplantation and regenerative medicine, new materials and medical equipment, health threats connected with condition of our environment in particular the impact on health of the quality of air, water and other aspects of the natural environment.

There is a need to speed up the development of new ideas and the creation of new medical technologies which have already reached a high level in Poland or the world or which may be considered as fast developing and offering good opportunities or exploitation. The area of Health and Living corresponds with one of the current strategic objectives of the European Union's Science and Social Policy.

The main goal was therefore to contribute to research and policy for Public Health by helping to:

- Define priorities in the area of research and technological development by detecting potential opportunities.

- Encourage other social groups to participate in the debate on the future.
- Present the significance and achievements of scientific research to economic growth and the possibilities for them to be absorbed by the economy.
- Change the focus of research and innovative policy from that for a traditional economy to that for an economy based on the creation and exploitation of knowledge.

Methodological Issues

Due to time and cost restrictions the methodology of the Pilot Foresight Project was based on the following foresight tools and techniques:

- **A Steering Committee** nominated by the Minister of Science was set up in order to coordinate all activities. Subsequently this committee appointed the **Main Topic Panel** to coordinate the Pilot Foresight Project. A group of four experts was chosen from the scientific groups of **The State Committee for Scientific Research.** This committee was a central administrative body whose members were representatives of scientific circles and government officials. The task of the four experts was to nominate experts to the Pilot Foresight Project.
- **Eleven thematic panels** in the health area were selected based on nominations of institutions and organizations authorized to name the candidates. This stage of the work involved the completion of a questionnaire by nominees and a process of co-nomination. Each panel was composed of a group of 10 to 18 experts coming from science, industry and public policy.
- I**dentification of Key Technologies** using specifically selected criteria and developed by the Main Topic Panel experts. This work makes it possible to determine priorities for a country's science, technology and innovation policies on the basis of future needs of the economy and society.
- **SWOT Analysis** was applied to each segment of 'Health and Life Science'.
- **Expert Panel Discussion**s involving groups of 10 to 15 experts were very effective in providing measurable results in relatively short time and made it possible to increase the number of actors involved representing various interests and social groups.
- **Social Consultation** was employed not only to optimize and substantially motivate the choice of priorities but to enable a broader group of stakeholders to express their views on priorities to ensure the country's development. The aim was to involve a cross section of society to help achieve buy-in to the results eventually obtained.

The following project-phases of the project can be identified:

- All thematic panels gathered the data and prepared SWOT analyses.
- A set of criteria to select priority research areas was established.
- First lists of priorities were prepared by panels.

The eleven thematic areas were:

- Primary and secondary prevention.
- Diagnosis and treatment of disease. This concerned all diseases which occur on a large scale or which are capable of spreading quickly among members of the population.
- Methods and technologies supporting intensive therapies.
- Veterinary protection of public health.
- Medical and psychological rehabilitation.
- Bioinformatics and biomedical engineering.
- New bio- and nanotechnologies in medicine and healthcare.
- Conditions of the quality of life.
- Food safety and health.
- Food production and the environment as well as environmental protection.
- New pharmacological methods and social pharmacy.

All eleven themes mentioned were analysed during three or four meetings of each panel. Members of thematic panels described weaknesses and strengths of represented area and after the discussion critical areas were identified and final reports based on these activities were prepared.

The 'social consultation' was carried out by the Pentor Institute for Opinion and Market Research, an organisation which specializes in public opinion surveys. With their help four focus-group interviews were conducted, 20 in-depth interviews were undertaken and a survey with 120 experts was carried out.

The final report was based on the findings of the surveys as well as reports from each of the eleven thematic panels. It was compiled and edited by the members of the Main Thematic Panel.

Main Findings of the Pilot

During the foresight process many issues were selected by experts as priorities. In order to choose the most important ones the Main Thematic Panel used the leads that emerged from the reports of the eleven panels and classified priorities into two different categories 'high priority areas' and 'priority areas'.

On the sub-theme of 'Fighting Diseases and Educating People' the selected **HIGH PRIORITY** areas were:

- Development of effective screening test systems,
- Development of perinatal care, early detection of genetic and development defects,
- Development of medical rescue methods and techniques.

The PRIORITY areas were:

- Development of the methods and technologies for the needs of the public pro-health education.
- Construction of programmes for continuous development of nutritional awareness and rationalization of society's nutritional habits.
- Development of methods and techniques associated with prevention, diagnosis and treatment of contagious diseases and infections that are important from the public health's point of view.
- Development of methods and techniques of ergonomic shaping of the living and working conditions, with a special focus on the elderly and handicapped people.
- Development of methods and techniques associated with prevention, diagnosis and treatment of disorders related to advanced age.
- Research on stress and development of methods to reduce it.
- Development of research and technologies concerning genetically modified organisms and monitoring of their impact on the human beings and the ecosystem.
- Improving food and eating habits within the context of their significance to the protection of human and animal health, with a special focus on natural biologically active substances.
- Development of rehabilitation methods and techniques related to somatic and mental disorders which are of great public interest.

A Healthcare System in Pain

The aim of the introduction of the **social consultations** to the Pilot Foresight Project was to achieve three basic objectives, namely:

- To initiate a sense of cooperation and participation among the participants;
- To maximize the effectiveness and pertinence of the decision processes;
- To obtain the social acceptance of the decisions made during the project.

The results of the social consultation showed that the priorities recommended by experts were on some points different to those of representatives of the general public. The representatives of the public identified the most important challenges facing Polish society in the area of 'Health and Life-Science' as being:

- Poor organization of the healthcare system (a sentiment reflected by 29% of respondents).
- Insufficient funds spent on healthcare.
- Insufficient availability of diagnostic techniques
- High prices for medication.
- Insufficient scope and extent of screening tests.

Public Awareness at All Levels

This Pilot Foresight Project was undertaken to determine and assess the future needs, opportunities and threats associated with social and economic development and help prepare in advance appropriate measures in the field of science and technology.

The foresight process itself, as well as its results, were used as a means of determining priorities for science, technology and innovative policies and as a tool for fostering a culture of thinking about the future.

Only when we know what is about to happen, what may happen or what challenges we will face, can politicians, managers and people in general make a choice between various alternatives for action.

The foresight programme allowed the representatives of the public authorities, industry, non-governmental organizations, research organizations and society to get involved in an open and guided discussion about the future. The results of the foresight informed decision-makers about new development trends and helped them to agree on development scenarios and harmonize the activities of the stakeholders. The participation of representatives from government, the scientific and industrial communities as well as actors in small and large enterprise in different sectors of the economy has been instrumental in determining criteria for the financing science and technology.

The general message resulting from the completed exercise is that there are some research areas of key importance to the country's social and economic development. Taking into account the resources needed to develop all these areas Poland should focus on fields and areas which represent a high international level using the criteria of financing science and technology areas elaborated during foresight activities.

The Health and Life Science area is the field that concerns health-related services and products. The significance of this sector becomes more and more important so there is a need to solve problems connected with healthcare such as aging, nutrition, pro-health education, prevention, diagnosis and treatment of diseases with widespread social impact, ethical and many other issues. Future oriented information is indispensable to decision making.

In this particular area many efforts to improve the health status of society should be made together by public authorities as a whole, researchers, industry and also the society itself.

Impact on the National Framework Programme

The first step in using the findings of the foresight programme carried out in Poland is that some of the domains that were selected by experts as key areas have already been placed into the National Framework Programme.

Healthy Nutrition

This field covers issues related to the development of production and rules of evaluating healthy food which are based on nutrigenomics. The development of healthy food production methods should become one of the pillars of agricultural policy and one of the main efforts fostering health in Poland and in the European Union.

Veterinary Protection and Public Health

The priority direction should include:
- The use of molecular and cellular biology to identify and analyze the risk of appearance of animal and animal-derived diseases,
- To assess the quality of animal-derived fodder and food, and
- To develop alternative methods of evaluating medical products used in protecting animal health.

The usefulness of the Pilot Foresight Project will depend on the policymaker's involvement in shaping the future by using new tools for developing science policy and supporting close collaboration between key stakeholders. The big emphasis for the future should be put on creating the climate for common work.

Success will depend also on the ability of commercial application of technological achievements.

Sources and References

www.foresight.polska2020.pl

Turkish S+T Vision 2023

Author:	Ozcan Saritas/ Ozcan.Saritas@manchester.ac.uk		
Sponsors:	TUBITAK – The Scientific and Technical Research Council of Turkey		
Type:	National Technology Foresight Exercise		
Organizer:	TUBITAK - The Scientific and Technological Council of Turkey		
Duration:	Jan 2003 to July 2004	Budget: € 200 000 (approx.)	Time Horizon: 2023

Summary

'Vision 2023: Strategies for Science and Technology' is a national project aimed at providing Turkish stakeholders with a vision for the development of science and technology vision in Turkey over a period of 20 years. It involved comprises four strands: Technology Foresight, Technological Capacity, R+D Manpower and R+D Infrastructure. The Technology Foresight strand provided the backbone of the Vision 2023 project. The remaining three programmes supporting the Foresight strand by collecting data on the existing science, technology and innovation capacity, hard data on R+D manpower as well as R+D infrastructure, as well as an inventory of national technology assets and an overview of the institutional and legal framework for research prevailing at this time.

From Fragmentation to Foresight

Although the Turkish Republic has strived to further social, economic and industrial development since its foundation in 1923, the first attempts to formulate an S+T policy coincided with the introduction of the First Five Year National Development Plan in 1963. TUBITAK - the Scientific and Technological Council of Turkey was established in the same year was given the mission of designing, promoting and coordinating science and research activities at national level.

During the 1960s and 1970s S+T policy in Turkey was mainly based on the 'promotion of basic and applied research in the natural sciences'. In this early phase, S+T policy was formulated by TUBITAK on the basis of tacit consensus with the government and without any official policy document. As in many countries these earlier attempts occurred in a context which lacked a participatory policy-development culture. Most decisions in the government and government agencies were based on very short term necessity and policies as a result were often piecemeal. The concept of technology policy and its integration with the industrial, employment and investment policies was introduced in the Fourth Five Year National Development Plan covering the period 1973-1977.

Until the turn of the millennium there was little success in realising concerted actions of the rather fragmented S+T actors around the priority areas. Assessments of S+T policy measures of the time show that the measures themselves were not to blame. S+T policy implementation has always been difficult in Turkey. The main reasons have been a:

- Lack of ownership of the R+D agenda by stakeholders,
- A lack of political support,
- A low level of dissemination,
- Isolation of S+T from other policy domains, and
- Fragmentation of research and of research resources.

Eventually the SCST or Supreme Council for Science and Technology decided that new national S+T policies were needed and that priority areas should be established for the next two decades in order to create an innovative economy and society by 2023 – the 100th Anniversary of the foundation of the Turkish Republic. TUBITAK as the general secretariat of the SCST developed the initiative 'Vision 2023: Science and Technology Strategies' and it was approved by the Council in December 2001.

'Vision 2023' includes the first-ever Turkish national foresight exercise. This is accompanied by three sub-projects that aim to collect and evaluate data on the current science, technology and innovation capacity of the country.

Raising Awareness for S+T

TUBITAK as the key actor in the Technology Foresight initiative suggested using Foresight as an instrument to overcome the problems related with the lack of participation, isolation and fragmentation in planning and implementation of S+T policies. The SCST stated aim of the programme as 'to implement a long term technological foresight programme for establishing a strategy, considering scientific, technological, socio-economic and political trends in the European Union and in the world and taking into account similar exercises previously conducted as well as using input from other modules of the Strategy Document'.

Turkey has suffered from a low level of funding for R+D and TUBITAK has found it very difficult to convince politicians of the importance of science and technology research investments for long term economic growth. The science system also suffered from a general lack of resources to support the development of technologies of the future. The 'Vision 2023' programme was intended to obtain the commitment of stakeholders, most importantly of politicians, to addressing these weaknesses. Foresight was seen as a useful method for creating the commitment that would bring together researchers, private companies, academia and non governmental organizations with a view to influencing politicians. 'Vision 2023 Technology Foresight Programme' was started in order to:

- Build a science and technology vision for Turkey.
- Determine strategic technologies and R+D priorities.
- Formulate an S+T policy for the next 20 years.
- Involve a wide range of stakeholders.
- Create public awareness of the importance of S+T for the overall socio-economic development of the nation.

The major client was TUBITAK, an agency that funds R+D projects and develops R+D human resources in Turkey. The TTGV or Turkish Technology Development Foundation which funds R+D projects via World Bank resources became a client as well.

Looking Abroad for Incentives

At the start of the exercise TUBITAK analysed foresight programmes in countries such as Japan, the US, the Netherlands, Germany and the UK. During the reviews of other programmes, the use of expert panels and of Delphi survey techniques stood out as being widely used. These methods were considered useful for the Turkish situation. The designers of the Turkish foresight exercise were looking for methods that would bring tangible benefits in terms of real outcomes. The Delphi concept was easy to understand and relatively easy to use especially for those who had never been directly involved in a foresight exercise before.

Foresight as a Tool to Support National Networking

Eventually the overall approach adopted included:

- **Expert Panels**,
- A two-round **Delphi Survey** to be executed by a Project Office in co-ordination with the panels, and
- **A Prioritisation Scheme**.

The main function of the expert panels was to identify technologies to be developed in the future and thereby anticipate the demand for new technologies. The use of panels also provided 'process benefits' in terms of network development and communication among stakeholders.

By considering the technology-supply issue, the Delphi process addressing the likelihood of achieving the envisaged technological developments and tested them against a set of prioritisation criteria.

A **Steering Committee** was in charge of the prioritisation process. Various criteria were used to make a comparative assessment of the contribution of different technologies to socio-economic development of the country. The technologies were assessed by considering their impacts on:

- Competitive strength,
- Science and technology innovation capability,
- Environment and energy efficiency,
- Creation of national value added by local resources, and
- Quality of life.

Panels to Reflect on Key Drivers and Trends

The **panels** were assigned to evaluate the current situation in their own fields by analysing **key drivers** and **trends** on the basis of **desk research and SWOT**. They used **brainstorming** techniques to build a vision and **voting** to **prioritise TTAs** or technological activity areas. **Cross Impact Analysis** was used to develop the vision and check it for consistency.

A standard **Task Definition Document** was given to all panels. This document identified four phases that the panels were expected to go through:

- Vision Building,
- Dissemination,
- Delphi, and
- Policy Proposals.

The steps necessary in each phase were also given to the panels in the two-page Task Definition Document that served as a background document. However, they were also allowed to work in different ways and use different methods to achieve expected outcomes. Thus, each panel was free to follow a different course or to make amendments provided they are able to systematically support and justify their decisions. As a result some panels used additional techniques such as workshops.

Government, industry, academia and NGOs were the main stakeholders and participants. **The Steering Committee** of the 'Vision 2023' programme consisted of 65 representatives from 27 Governmental institutions, 29 industrial organisations and NGOs, as well as 9 universities. It guided the project by taking strategic decisions and by approving the reports and policy recommendations.

Operational and budgetary decisions were taken by the **Executive Committee**, chaired by the **President of TUBITAK** and bringing together three representatives of the Steering Committee with related administrative officials of TUBITAK.

Social Signals of Demand for a Vision

'Vision 2023 Technology Foresight' was a national level 'holistic' programme covering main socio-economic sectors in the country and relevant themes. The main reason for focusing on the socio-economic sectors was because they were seen as the only structured body from which to get signals of the demand for science and technology. They were also considered as the main 'implementers' of science and technology policies.

In its first meeting in April 2002 the Steering Committee selected the sectors on which the work would focus on the basis of two main criteria: Selected sectors were those with:

- A competitive advantage today that might likely persist for the next 20 years, or
- Sectors of relevance to other policy domains.

Identifying Strategic Fields

Following the constitution of a list of possible priority sectors, a voting session was carried out. The selected sectors were represented with 12 panels 2 of which were cross-disciplinary in nature. The selected panels were:

- Education & Human Resources,
- Environment & Sustainable Development,
- Information & Communication,
- Energy & Natural Resources,
- Health & Pharmaceuticals,
- Defence, Aeronautics and Space Industries,
- Agriculture and Food,
- Machinery and Materials,
- Transportation and Tourism,
- Textiles,
- Chemicals,
- Construction and Infrastructure.

The Technology Foresight exercise was completed in early 2004. The tangible outputs of the exercise included 24 reports, made up of 12 panel reports, 1 Delphi report, 3 synthesis reports and 8 reports from **Strategic Technology Groups.**

The synthesis reports were produced with the aim of bringing panel outputs and the list of priorities. The Project Office amalgamated 94 TAAs proposed by the panels under 69 headings. It classified them into four categories by considering their relevance to or impact on:

- Competitive Advantage,
- Quality of Life,
- Sustainable Development, and
- Information Society.

Finally a workshop was held to identify **Strategic Technology** Fields underpinning above-mentioned four TAAs. The Project Office grouped those technology fields in eight categories. These categories and their relevance to Turkey's scientific, technological, economic and social development can be summarised as follows:

Information and Communication Technologies: The Foresight exercise revealed that all the sectors of the Turkish economy will exhibit demand for these technologies as a basis for advancement in the future.

Biotechnology and Genetic Engineering: These fields were seen as important for based on the consideration that they provide critical input for health, agriculture and industrial production sectors. Analysis indicated that Turkey has the potential to become a world player in certain domains of molecular biology, biotechnology and genomics. Health and agricultural sectors were considered the first industries to benefit from these fields starting from about 2010.

Nanotechnology: This was seen as a revolutionary topic with a wide range of potential applications such as the development of lightweight super-strength materials, the development of new generation computers, enhancement of the human nervous systems, and reduction of environmental pollution. Scientific, technological and industrial advances in this area were considered to play a fundamental role in the future in wealth creation and in national defence.

Mechatronics: The development and production of integrated human-machine products were seen as a key area to be investigated through research on micro- and nano-electro-mechanic systems and sensors, robotics and automation technologies, and other generic areas including control technologies and algorithms, micro-mechanics, micro-electronics, and embedded software. These technologies were seen as keys to increase competitiveness in sectors that are already well developed in Turkey's such as automotive, household goods and defence.

Production Processes and Technologies: These areas were considered important for the sustainability of competitiveness in areas such as automotive engineering, textiles and household goods production. Since it is now easier for these sectors to move their production facilities from one country to another around the globe, remaining competitive was considered essential. Areas such as flexible production systems, rapid prototyping systems and material shaping systems were identified as priorities for future investigation.

Material Technologies: The materials sector provides input to all industrial activities including aerospace, communications, defence, automotive and construction. In the exercise a number of specific technologies were identified as important for further development. Turkey holds the largest Boron reserves in the world and so boron technologies are considered important as were composite materials, polymer technologies and smart materials.

Energy and Environmental Technologies: The development of new energy sources and the use of existing natural resources in the most efficient and cleanest way was also considered a key issue for the future. For this purpose R+D activities on the following technologies were identified as being crucial: Hydrogen technologies and fuel cells, renewable energy, nuclear energy, environmentally sensitive fuel and combustion technologies, as well as water treatment and reuse technologies.

Design Technologies: Design was considered to play a fundamental role in new process and product development and in increasing the productivity of existing processes and products. In order to achieve these goals key areas included virtual reality software and virtual prototyping, simulation and modelling software, grid technologies, parallel and non-parallel computing software development.

It was considered that these were the areas in which Turkey needed to develop capabilities and achieve improvements. For this reason groups of experts called **Strategic Technology Groups** carried out detailed technical studies in order to set the strategies in each of these technology categories in the form of a 20-year roadmap. Finally TUBITAK formed a **Strategy Group** whose mandate was to prepare a document based on the findings and recommendations of the previous reports. The Strategy Group submitted a report, entitled 'National Science and Technology Policies: 2003-2023 Strategy Document' in August 2004.

Increasing the R+D Budget

The 'Vision 2023' process mobilised a considerable number of people from industry, academia, government administration and NGOs. It attracted the attention of mass media and resulted in the drafting of an S+T policy document with a 20 year perspective. This was submitted to the government and in line with essential recommendations of the strategy document the government has recently announced a decision to increase R+D expenditure. The governments stated aim is to increase Turkish GERD from 0.64% to 2% by the year 2010. The government has set aside additional public funding to the value of €275 million in 2005 to support human resource development and to promote science and technology in society and industry.

On the basis of resolutions announced at the '2004 Turkish Economic Congress', the State Planning Organisation has adopted the Report of the S+T Policies Working Group. This report was exclusively based on findings and recommendations outlined in the synthesis reports of the Foresight exercise.

Although a systematic evaluation of the exercise has not yet been carried out, there is strong evidence that the 'Vision 2023' Technology Foresight exercise has made a real contribution to communication and networking among stakeholders and increased awareness of science and technology issues at national level. The impact of the whole process and its various outputs will be easier to evaluate after the announcements of increased public funds for research and after a clarification of policy regarding the next round of the exercise.

Sources and References

- TUBITAK Vision 2023 web site: **http://vizyon2023.tubitak.gov.tr** (in Turkish)
- FORLEARN Online Foresight Guide: **http://forlearn.jrc.es/guide/6_examples/index.htm**
- Saritas, O. (2006). *Systems Thinking for Foresight,* Unpublished Ph.D. Thesis, PREST, University of Manchester.

Converging Technologies Enabling the Information Society

Author:	Marc van Lieshout of TNO the Netherlands / marc.vanlieshout@tno.nl
Sponsors:	The IPTS (Institute for Prospective Technology Studies), Seville
Type:	Preparation for Foresight - Agenda building and Analysis
Organizer:	TNO - Organisation for Applied Research - The Netherlands CWTS - The Centre for Science and Technology Studies - University of Leiden, The Netherlands VDI - The Union of German Engineers - Germany
Duration:	Jan 2005 to Nov 2005 — Budget: € 200 000 — Time Horizon: present and near future

Purpose

The purpose of the project was to analyse the scientific strengths of the EU compared to the USA and Japan in the field of 'converging technologies' with the aim of informing and influencing the European research agenda.

Does Convergence Really Exist?

The US NBIC initiative on nano-, bio-, info- and cogno-science domains as well as the European High Level Expert Group 'Converging Technologies for a European Knowledge Society' have identified the convergence of technologies as an important technological development that will have a significant impact on all aspects of human life.

Both reports are based on visions of the future rather than on a solid evidence base. Indeed the question is often posed whether convergence really is taking place or not. It is still an open issue whether a convergence of Cognitive Science with domains such as Information and Communication Technologies is actually taking place. However many experts agree on the possibility of radical breakthroughs occurring should this be the case.

Our study aimed at presenting an analysis of relevant strengths and weaknesses of the EU in the whole area of converging technologies. It took ICT as a core technology and examined the convergence of ICT with Cognitive Science, Biotechnology, Nano-technology and the Material Sciences. It also set out to identify related prospective areas of research for the European research agenda, in particular in the area of converging technologies on the boundary between cognitive science and ICT.

Statistical Findings

The first main task was a **bibliometric analysis** of the strengths and weaknesses of the EU compared to the USA and Japan. For the EU a breakdown to the EU-25 countries has been provided. The bibliometric analysis was based on separate sets of keywords identified for each of the following disciplines:
- ICT,
- Cognitive Science,
- Biotechnology,
- Nanotechnology and,
- New materials.

This was used to distil relevant publications from the Thomson scientific database. Publications in convergent clusters such as ICT + Cognitive Science or ICT + Biotechnology, to name but a few were matched to show the overlap and estimate the level of convergence between fields. Convergence measured in this way was analysed in terms of the:
- Level of scientific activity by estimating the size of the cluster of publications, as well as the
- Impact based on figures for citation normalized each respective discipline.

A study of trends on the basis of Vision Documents, Foresight Reports and Technology Roadmaps complemented the bibliometric analysis.

For the convergent cluster Cognitive Science + ICT the bibliometric analysis was supplemented with a patent analysis.
National research programmes in the EU, the USA and Japan were inventoried to present an overview of national activities within the convergent clusters for each of these countries - the EU, the USA and Japan.

Gross figures regarding the distribution of centers of excellence within the EU-25 were presented on the basis of scientific activity and impact figures.

Possible Impact on the Future European Research Agenda

The impact of the phenomenon of technology convergence in the case of the convergent cluster of Cognitive Science + ICT was explored in detail in a dedicated workshop organized with the intention of building a vision for a European research agenda based on convergence.

Violating Boundaries between The Human Mind and Body

Regarding socio-economic and cultural trends the study concluded that in many converging areas study it is possible to perceive the introduction of tools and devices which are on the one hand small or very small and on the other hand cross boundaries between the human body and the human mind. For example the use of artificial neural networks for various kinds of daily 'routines' in which selection and identification processes are used is increasingly common. Optimistic voices refer to a 'new renaissance' being at hand. More critical observers express concern about the implications of these new technologies and applications. In any case the socio-economic impact of this convergent cluster is believed to be potentially very high. It is expected to provide benefits for emerging as well as growing markets, not only in the health care sector but also in areas of application such as robotics in the broad sense of the term.

Cognitive Neuroscience at the Forefront

Within the convergent cluster of Cognitive Science + ICT one can perceive the emergence of intelligent devices that mimic cognitive processes of the brain and the mind in:

- Sensing,
- Perceiving,
- Memorizing,
- Controlling,
- Acting, and
- Learning.

Cognitive neuroscience supported by brain imaging techniques is at the forefront of developments in cognitive science and has strong links with developments in neurobiology.
Brain-machine interfaces coupled with robotics provide opportunities to create systems that can operate under circumstances that are difficult, dangerous or simply impossible for human beings:

- Disaster zones such as earthquake sites,
- Deep sea, or
- Outer space.

Cognitive vision systems that enable intelligent monitoring processes, speech and language processing technologies also feature amongst the technological trends within cognitive science and ICT.

Within Biotechnology + ICT convergent cluster developments were identified that brought together bio-informatics and computational biology to provide technologies for:

- Non-invasive monitoring and diagnosis based on biosensors and biomarkers,
- Biological computing, and the
- Development of virtual environments to manipulate genetic properties of organisms.

Within the Nanotechnology + ICT cluster developments were identified within;

- Nano-electronics for nano-scale medical diagnosis and treatment, for cleaner, safer and more comfortable transport, and for anti-terrorism and security applications,
- Nano-photonics for fiber-optic communication, optical data storage, quantum dots, simulation and modeling techniques as well as image processing and pattern recognition.

Finally, new trends within the Material Sciences + ICT convergent cluster show overlaps with other clusters. This is especially true in the terms of the attention given to simulation and modeling, image processing, pattern recognition and neural networks. The overlap with Nanotechnology + ICT is particular strong in the area of electronics.

Applications in Medicine and Robotics

These trends provide opportunities in a variety of fields including:

- Diagnosis and treatment in the field of medicine on the basis of markers and sensors,
- Brain imaging, deep neural stimulation and robotic surgery,
- The application of robotics to the exploration of outer space and deep sea as well as personal care and industrial processes,
- New modes of computing based on biological computing and nano-computing paradigms,
- New and advanced simulation and modeling techniques,

- Pattern recognition techniques based on the application of artificial neural networks in a great range of potential application domains.

The many visionary and roadmap documents that we studied, formulated challenges that remain to be overcome. These included challenges as ambitious and as inspiring as fully mimicking the human brain with the use of artificial neural network to replace the cognitive vision system. It has to be noted that many of the formulated technologically advanced challenges may not be realized for decades to come.

Europe's Comparative Advantage

Strong Input but Weak Output

Convergence is visible in all four clusters, though for now Material Science + ICT exhibits only modest convergence. Scientific activity in Europe as measured by the number of publications is overall higher than that in USA and Japan in all of the convergent clusters, except in the case of Biotech + ICT where USA has a slightly lead.

In terms if scientific impact as measured by the normalized citation score, the USA however leads in all clusters with the possible exception of Nanotechnology + ICT. In this case however reliable figures are hard to come by.

With regard to the centers of excellence, this study showed that the USA has a marked lead over Europe in terms of 'middle average' centers of excellence. In terms of high end centers of excellence however the USA and Europe are more balanced. This is especially the case for the Cognitive Science + ICT cluster and slightly less balance in the case of Biotechnology + ICT and Material Science + ICT. The figures for Nanotechnology + ICT are hard to interpret in a reliable way.

The overall conclusion is that Europe performing well in terms of input (scientific activity) but lags the USA in terms of output (scientific impact). The structural conditions reflected in the status and distribution of centers of excellence show that Europe is rather closely aligned to that in USA for the upper segment but is losing ground in the middle segment.

The position of Europe compared to Japan is quite good overall. Japan outperforms Europe only with respect to the impact score on Cognitive Science + ICT.

National Promotion of Convergent Clusters

Europe shows a relatively balanced set of research activities on a national scale and on a European scale regarding the convergent clusters. However not all European countries contribute equally well to developments within each cluster. In particular the contribution of new European member states lags that of the rest of Europe.

The new member states focus more on participation in European research programmes rather than developing their own activities. Most countries have adopted specific strategies to promote participation in research activities focused on convergent clusters.

US Ability to Commercialise Knowledge

The study showed that continued and intensified attention to the role of convergent clusters is justified. One can recognize the European knowledge paradox within these convergent clusters: Europe has a good and solid reputation regarding knowledge creation but lags the USA in terms of knowledge commercialization.

Major issues identified during the course of the study as being important for improving the European position are:

- **The role of Knowledge Centers:** To help actors to concentrate on multidisciplinary research, to balance long term visionary ambitions with realistic mid-term goals, to adopt the European innovation model in which societal implications are part of the research strategy.
- **The role of Industry:** Moving from a technology push towards a market demand model, involve SMEs in research and application development, to develop high-risk/high-gain activities alongside more secure, robust and versatile applications.
- **The Need for Communication:** In particular there is a need for communication with the public at large concerning ethical issues that accompany convergent technologies. There is a need to appraise the socio-economic, ethical and legal dimensions of converging technologies, to involve those affected most in a dialogue on converging technologies and to develop an ELSA test-bed to address the spectrum of Ethical, Legal and Social aspects of these domains.

New Opportunities for SMEs

Critical factors identified in the study relate to shaping scientific challenges and bridging the gap between grand scale scientific research programmes and application oriented activities. Part of the research within converging technologies is bound to big programmes or requires huge investment in equipment and instruments. The development of applications however is often feasible for innovative SMEs despite their relatively modest resources. The successful combination of and co-operation between SMEs and research institutes is seen as a critical success factor in harnessing convergent technologies for growth and prosperity in the future.

Discussing the Social Implications

The awareness and attitude of the public at large is another critical factor. Important social, economic and ethical considerations arise in the development of convergent technologies.

To ensure a broad societal uptake of new products and services for example in areas such as health care, a broad debate involving various stakeholder groups is seen as a critical precondition for the successful dissemination and uptake of related technological innovations.

Finally the study notes that actors do not consider it necessary to establish a central large-scale research institute to co-ordinate all research activities in convergent technology domains. Support for mid-sized institutes requires a more de-centralized approach in which not only elite research institutes are financed but a broader group of actors necessary to support the successful development of convergent technologies across all countries of Europe and all sectors of the economy.

European Discourse on Converging Technologies

The findings of the TNO study is being used by IPTS to drawing up its own conclusions and formulate the final project report.

Disseminating these findings to a broad audience is one of the ways it will contribute to the European discourse on converging technologies.

The IPTS will use these findings to influence the European research agenda in the field of converging technologies in line with the above formulated opportunities and their broader implications for society and the economy.

Sources and References

Marc van Lieshout, Christien Enzing, Gabriela Bodea, Annelieke van der Giessen (TNO), Andreas Hoffknecht, Dirk Holtmannspötter (VDI), Ed Noyons (CWTS). Converging Technologies for Enabling the Informatino Society. Report to IPTS. November 2005.

Marc van Lieshout, Gabriela Bodea (TNO), Norbert Malanovsky (VDI). Building a Vision for a European Research Strategy on Converging Technologies. Report to IPTS. November 2005.

For any further information concerning the project please refer to Marc van Lieshout (TNO) at marc.vanlieshout@tno.nl or to Ramon Compano (IPTS) at ramon.compano@cec.eu.int

Imagineering Ireland: Future Scenarios for 2030

Authors:	John S. Ratcliffe / john.ratcliffe@dit.ie Ruth Kelly / ruth.kelly@dit.ie		
Sponsors:	The Futures Academy, Faculty of the Built Environment, Dublin Institute of Technology (DIT), Ireland.		
Type:	National Foresight Exercise		
Organizer:	The Futures Academy, Faculty of the Built Environment, Dublin Institute of Technology, Ireland.		
Duration:	2004-2005	Budget: N.A	Time Horizon: 2030

Purpose

In contemporary society, it is well recognised that public policy, corporate strategy and individual choice, and the way in which they are conducted, is becoming increasingly complex. Consequently, in the context of this rapid change and heightened uncertainty, a better and more versatile understanding of the future and the powerful forces influencing its evolution, is required to assist in policy formulation and decision making at every level across all sectors. In 2005, the Futures Academy, Dublin Institute of Technology, Ireland, produced a document Imagineering Ireland – Future Scenarios for 2030 to demonstrate how scenario development can be used in Ireland to explore the opportunities and threats that lie ahead for the nation over the next few decades.

Contradiction, Competition, Contention

Currently, Ireland is a country of contradiction, competition and contention. Contradiction, in that, on the one hand, after a decade of sustained economic growth, it is one of the wealthiest nations in Europe, with higher numbers in employment than at any time since the birth of the state, low levels of taxation and government indebtedness almost the lowest in the euro-zone. On the other, the disparity between rich and poor is the widest in Europe, the physical infrastructure of Third World quality, the health service in shambles, and some of the old virtues that made Ireland and the Irish so special fast disappearing.

Competition, for the enterprise model that has worked so well to-date, will almost certainly have to be modified considerably if the economy is to flourish and progress over the decades to come. What surely is needed now is a greater emphasis on fostering a new enterprise model that is market-led and knowledge-based.

Contention, where, in common with most other developed societies, such issues as migration, addiction, crime, pensions and the environment evoke a range of conflicting emotions. In response to these challenges, The Futures Academy at the Dublin Institute of Technology recognised the necessity to anticipate and prepare for complexity and uncertainty and in 2005 developed a range of possible and plausible scenarios for the future of the island of Ireland. The objectives of this exercise were to:

- Detect the priority national issues for study (key variables) by identifying relationships between specific driving forces of change (technology, society, environment, economy, governance, demography and culture).
- Determine the main actors and their strategies, and the means at their disposal for bringing their projects to a successful conclusion.
- Describe, in the form of scenarios, a range of possible and plausible development trajectories for the island of Ireland, by taking into account the most probable evolutionary path of the key variables and by using sets of assumptions about the behaviour of the various actors.

The Process

The following stages are typical of the development process employed by the team.

- **Set the Strategic Question** – central to this is the holding of strategic conversations with key actors in society.
- **Identify the Driving Forces of Change** - categorised by a technique such as the 'Six Sector Approach' (societal, demographic, economic, environmental, governance, technological).
- **Determine the Main Issues and Trends** — identifying the issues and trends relevant to the strategic question.

- **Clarify the Level of Impact** upon the strategic question and degree of **Uncertainty** (likelihood of occurring within the given timeframe).
- **Establish Scenario Logics** – logical rationale and structure for the scenarios.
- **Create a range of Possible and Plausible scenarios** – this will facilitate decision makers in testing policy options and moving towards strategic planning.

The **project team** consisted of selected members of The Futures Academy and the Dublin institute of Technology.

Trends Dominated by Diversity and Disruption

A number of trends were identified under the Six Sector approach but given space restrictions, we will focus on three: socio-economic, technological and governance trends.

Identified Socio-Economic/Cultural Trends

- The movement towards a more open, democratic and honest society will continue, and assist in fostering greater tolerance in an ever more diverse and multifarious community.
- Inexorably, though excruciatingly, the peace process will progress towards a more socially, economically and even politically integrated island of Ireland.
- Public service, be it in health, environment, enterprise, education, transport, communications or justice, needs to be instilled with a new pioneering spirit on the part of legislators and administrators alike.
- The demise of older traditional values, customs and beliefs, and the absence of newer ones to replace them, leads to a growing feeling that the social fabric of the state is torn and in urgent need of repair.
- Build a society based on the great cardinal civic virtues essential to a well-functioning democracy and the common good, being: the generous impulse, the readiness to be compassionate, the facility to modulate self-interest, the sense of fair play, and the assumption of duty.
- The national figure for suicide, especially among young men, has been on the increase for the past decade, and shows few signs of abating.
- Statistics show that the extent and prevalence of drug misuse, particularly by the young, is high and rising, requiring an innovative search for a set of effective solutions backed by adequate resources.

Enlarging the Value-chain of ICT

As the world moves towards new frontiers in biotechnology, nanotechnology, and combined spheres such as digital genomes, the country should continue to examine what it has to offer from an educational, industrial and governmental support perspective. Major trends include:

- An Tánaiste has called for the creation of a civic science in Ireland, meaning: a science engaged with and invited into the national dialogue; a science responsive to the public and worthy of public trust; and a science embraced and valued by students, parents, educators, industry, communities and government.
- The ICT industry in Ireland is positioned at a relatively low point on the value chain, dealing in mature technology that has been developed elsewhere, and needs to increase the value-added component in its ICT products and services.
- Scientific and technological industries in Ireland need an enlarged cadre of world class professional researchers who cannot only innovate but also contribute original marketable ideas that can form the nucleus of new globally competitive companies which can attract multinational investment.
- There is a need to build enterprise capability to develop products and services by ensuring that both national research and enterprise agendas are aligned, and facilitating this by developing strategic technology platforms, as well as encouraging greater collaboration between academe and enterprise.
- State investment in research is significantly lower than in most developed economies, and, as the Irish economy moves more and more to one based on knowledge and expertise, so the level of funding for research must grow.
- A Centre for Advanced Informatics should be established, with an independent identity and location, to conduct internationally recognised research and development relevant to industry.

Broadening the Base for Democracy and Peace

- Complex and tortuous though it has been, the peace process seems now to be at the beginning of the end, so long as the identities of both groups are fully respected and reflected in all the constitutional and institutional arrangements still to be determined, and a progressively structured partnership between North and South could lead to further dimensions of unification.
- As things stand, the future of Ireland is strongly linked to the future of the European Union, and in particular to the competitiveness imperative enshrined in the Lisbon Strategy, but current constitutional wrangling could lead to a reassessment of alignments and alliances.
- Different intergenerational agendas will appear across the State as the youth, the 'grey', the well-off workers and the disadvantaged collide in deciding who gets what, and how it is paid for.
- The influence of single issue lobbies similarly will grow, representing specific cultural, environmental, social or

economic interests. Somehow there is a need to engender greater appreciation of, and participation in the political process, and attract a higher caliber of person to engage in it and assume leadership roles.

The Scenarios

Liberty Americana: This scenario is based on expanding globalisation and growing libertarianism. There is a diminishing role for national government, and a growing emphasis upon international collaboration, largely aimed at facilitating global competition and enhancing market efficiency. The accent is on the individual, and the prime motivation materialist.

Equality Europa: This scenario is founded on a system of shared values, a fair distribution of opportunity and a desire for sustainable development. It is held that these are best attained through a strong framework of public policy under the aegis of a forceful European Union. The emphasis is on collective, collaborative and consensual action, shaped by commonly held attitudes and aspirations.

Celtic Fragility: This scenario is built upon the desire to preserve personal independence within a distinctive national identity. Patriotism dictates that political power remains with the nation state in an increasingly fragmented world. Most weight is attached to the furtherance of individual freedom, protected by state security, and conscious of cultural difference.

A New Mindset for Flexible, Adaptive Strategies and a Need for Futures Thinking

A new mindset is required by all agents of governance to anticipate and prepare for the future - one that that embraces individualism, collaboration and innovation, a mindset that addresses societal and environmental, as well as economic, imperatives, above all, however, a mindset that can tackle complexity, uncertainty and change. In other words, governance at all levels, in the post-capitalist era demands a total strategic commitment based on entirely new ways of thinking about organisations. This implies a mindset that is oriented to process rather than to structure; that is ecologically driven rather than hierarchically driven; that is value-added rather than competitive; that is holistic rather than functional; and that is collaborative and innovative rather than adversarial and derivative. A futures orientation, with strong strategic foresight capability and capacity, founded on flexible and adaptable systems, is the secret of success. To create the future one must first be capable of imagining it. Not predicting, not planning, not forecasting – imagining. Preparing a society or an organisation to anticipate that it could face a number of environments that are fundamentally different from the present is a radical departure from standard practice for most. But by learning to develop and use methods and techniques drawn from the 'futures field', agencies and organisations can take actions to make a desirable future occur, quickly adapt to unfavourable environments, and efficiently implement strategies that will succeed in many different social and market conditions.

Ireland becoming an Influential Small Nation

The hope, the dream, the 'prospective', is that by 2030 Ireland will become the world's most influential small nation the first true 21st Century country. Known for their resilience, adaptability and capacity for transformation, the Irish 25 years hence are admired around the world for their courageous and explicit commitment to enabling their fellow citizens to flourish as active and responsible co-creators of their lives, families, communities, economies and country. Memorably, the opening decades of the 21st Century witnessed the creation of a society founded on open-source organisations, networks and infrastructures which fostered and facilitated the history-altering work of socialising and supporting all Irish people to be co-authors in composing their future story, capacities that did not exist in 2005. Internationally the Ireland of 2030 punches well above its weight, it is viewed as the most 'future aware' jurisdiction in the world, having capitalised on a continuing programme of strategic foresight over a period of 25 years allowing successive governments, business organisations and civic agencies to envision, think-through and respond appropriately to the signals of change and the critical issues that are hidden within them. Inevitably, the best of the world's best willingly come to live, work and invest in Ireland in order to participate in, and learn from the success of a great 21st Century culture. The main purpose of Imagineering Ireland – Future Scenarios for 2030 is to promote the concept that Ireland needs generally more of a futures orientation, and specifically much greater omnipotence and capacity in the field of Prospective or Strategic Foresight. Ireland currently has no dedicated, world class independent Strategic Foresight institution. At a time in the nation's development when crucial decisions are needed in the key social, economic, political, technological and ecological arenas, this gap is a major weakness. There is, therefore, a need for a Strategic Foresight Institute for Ireland.

What would a Strategic Foresight Institute Do?

Depending upon how they are defined, there are many organisations in the world that perform the function of strategic foresight. Whilst they differ widely in scale, scope and special interest, what each has in common, is a central and explicit focus on some aspect of the futures domain. A composite view of their conventional characteristic activities can be listed as follows:

- They raise issues of common concern that are overlooked in the conventional short-term view; e.g. issues about peace, environmental stability, inter-generational ethics, the implications of new, and expected, developments in a number of fields. They highlight dangers, alternatives and choices that need to be considered before they become urgent.
- They publicise the emerging picture of the near-term future in order to involve the public and contribute to present-date decision-making.
- They contribute to a body of knowledge about foresight and the macro-processes of continuity and change that frame the future.
- They identify some of the dynamics and policy implications of the transition to sustainability.
- They help to identify aspects of a new world order so as to place these on the global political agenda.
- They facilitate the development and application of social innovations.
- They help people to deal with fears and become genuinely empowered to participate in creating the future.
- They help organisations to develop foresight strategies in relation to new products and markets, and to evolve in appropriate ways.
- They provide institutional shelters for innovative futures work which, perhaps, could not easily be carried out elsewhere.

Preventing Overshoot and Collapse

The main purpose of a Strategic Foresight Institute for Ireland is to facilitate the emergence and application of high-quality forward thinking in each major sector of the economy and section of society. It would contribute to formulating a long-term strategy encouraging wider social, cultural and economic shifts from an Irish society that is driven by the past imperatives of a 20th Century culture, and the short-term perceptions of the present, toward one that is increasingly open to the forward view and thus able to be futures-responsive. Without applied Strategic Foresight, the fear is that Ireland will stumble blindly into a process of 'overshoot and collapse' as the human species moves beyond certain well-known global limits. With applied Strategic Foresight, savage social learning experiences can be minimised. The human prospect can be altered by consciously engaging in the wholesale redesign of systems and moving toward a more balanced world. A world where Ireland leads the way!

"The future belongs to those who prepare for it today».
Malcolm X (1925 - 1965)

Sources and References

- Bertram G., Michalski, A. and L. Pench. [1999] Scenarios Europe 2010 European Commission Forward Studies Unit.
- Citron, M. and O. Davies [2005] "Trends Now Shaping the Future" The Futurist. March – April.
- Defence Evaluation and Research Agency [2001] Strategic Futures Thinking, Performance and Innovation Unit UK.
- Ratcliffe, J. [2002] "Scenario Planning: Strategic Interviews and Conversations", Foresight, Vol. 4, 1, 19-30.
- Serra, J [2001] "Territorial Foresight: More than Planning, Less than Prospective", Paper presented at Conference Creating and Applying Vision in the Regions, Dublin, December.

Emerging S+T Priorities in the Triadic Regions

Authors:	François Farhi	CM International	f.farhi@cm-intl.com
	Denis Lecoq	CM International	d.lecoq@cm-intl.com
	Karlheinz Steinmueller	Z-Punkt	steinmueller@z-punkt.de
	Annele Eerola	VTT	annele.eerola@vtt.fi
	Amnon Einav	Tel Aviv University	amnone@post.tau.ac.il
Sponsors:	DG Research		
Type:	Worldwide technology foresight		
Organizer:	European Commission - DG Research - Directorate K		
Duration:	18 months	Budget: € 200 000.	Time Horizon: 2035

Purpose

The objective of this Platform Foresight project is the analysis of emerging science and technology priorities in public research policies of the European countries, the US and Japan. The aim is to provide the European Commission and the member states with policy recommendations as to become leaders in these emerging technologies.

Context and Challenges Addressed

The study helped identifying scientific and technological developments and research priorities in which Europe could take the lead in the years to come. By providing recommendations for public policy support to emerging science and technology priorities, the study aims at contributing to research and innovation policies of the European Union.

Methodology and Main Steps

The global approach of the project comprises 3 major stages. Two main drivers have thereby been used as analytical focusing entry points: technology and public policy. The first stage deals with the identification of emerging issues in science and technology developments. Members of the consortium using existing foresight literature carried out this task through desk research.

The second stage consists of identifying potential leadership areas for Europe among the emerging science and technology developments. This stage is based on primary research in the form of an expert panel survey. This survey is thereby divided into two rounds. While the first round aims at identifying science and technology priorities for Europe, the objective of the second round is to analyse potential areas of leadership for Europe on the basis of an assessment of both the continent's strengths and weaknesses in the identified science and technology areas as well as the socio-economic factors for public policy support. The relative position of Europe compared to that of the USA and Japan is of utmost importance in this part.

The third stage aims at defining policy recommendations in support of the development of potential leadership areas for Europe. This stage is also based on primary research in the form of expert interviews as well as collaborative work arrangements favouring multiple interactions and exchanges.

Priorities in the 'Classical Fields' - Nanotechnologies, ICT, Environmental Technologies & Life Sciences

By means of a questionnaire sent to more than 300 experts, a list of 104 technologies – established by scanning foresight literature - has been evaluated. Four priority fields have been retained: nanotechnologies and new materials, information society technologies, life sciences and technologies for sustainable development. 40 technologies have been selected as the main priorities for the future.

Among the priorities identified in the fields of **nano-technologies, knowledge-based multifunctional materials, new production processes are:**

- Bio-active materials and surfaces based on bio-polymers, bio-compatible materials, bone replacement materials, nano-structured surfaces for implants, Titanium dioxide nano-particles for anti-bacterial surfaces, silver nano-particles as antibiotics, etc.
- Complete modeling for the transformation of materials and integration in databases - virtual chemistry.
- Nano-composites and nano-metrical-nano-scale reinforcements in electronics, chemistry and medicine.
- Design of structures with intelligent behaviour and response.

Among the priorities identified in the fields of **information society technologies** are:

- Software technologies for transport of digital data,
- Computer-aided surgery,
- Multipurpose intelligent and mobile robots,
- Image sensors for robot perceptive systems and other image processing applications.

Among the priorities identified in the fields of **sustainable development, global change and ecosystem**s are:

- Capture and storage of CO_2,
- Low-cost high-efficiency solar cells,
- More efficient energy consumption based on technologies such as hybrid cars, diode-based lighting technology, new technologies for monitoring and controlling heat and ventilation,
- New energy storage technologies using new approaches such as those based on flywheels, super-caps, supra-conducting magneto-electrical storage.

Amongst these 40 technologies, the highest priorities belong to the **life-science field including genomics and biotechnology** for health, such as:

- Cell therapy,
- New tools for in-vivo diagnostics such as contrast media for ultrasonic technologies and nuclear visualization methods,
- Application of stem cells in the treatment of different diseases such as neurodegenerative,
- Active packages, such as bio-degradable packaging and micro-sensors for food security and transparent food information.

The Economic Paradigm

The economic factors provide the most important rationale impacting public R&D support policies in virtually all priority fields with the partial exception of the field of Sustainable Development, and almost regardless of the geographical area.

Even though the relative importance of the economic variable may differ between countries, the related issues of international competitiveness, economic development and job creation form an integral part of most countries' public R&D policies.

The defining characteristics of the US public R&D policy are:

- An even stronger impact of the economic factors than in other geographical areas,
- The enormous influence of defence-related research activities, and
- The importance given to the high potential areas made up of converging technologies.

In the Japanese context economic issues play an equally dominant role motivating public R&D support policies in virtually the entire range of high priority technology fields. Moreover, the awareness of a number of the country specific conditions such as demography and geographic location provides additional but socio-environmental rationales.

Of the triadic regions, Europe is one most strongly influenced by societal factors. As a matter of fact, ecological and quality of life issues generally provide a unifying and defining element in European public R&D support policy.

Europe is faced with policy rigidities that have an important impact on the efficiency of public support. This influences both the form in which support is provided and the structure of the research organisation itself. In the USA, defence-related R&D activities and the creation of the NNI increase the efficiency of public policies. Europe does not have any such support mechanisms. What is more important, the key role of the environmental factor expressed through the precautionary principle and the relative weakness of policy institutions at European level seem to represent further obstacles to the creation of efficient public support structures.

Europe Sets Priorities in Sustainable Development

The field of information society technologies is to a large extent a reflection of present market realities and the corresponding presence of leading enterprises notably in Europe, especially in the area of mobile communication. This field provides an important potential for Europe, particularly as regards the newly emerging health sector applications, which is not least due to the relative importance accorded to societal factors in Europe.

Although sustainable development is considered an important issue by all governments it constitutes the field in which country specific differences are most significant.

Whereas most countries agree on the importance of sustainable development, there is no consensus on the technologies that are likely to promote this type of development. In the area of energy for example France favours nuclear technologies, Germany favours solar power and Spain favours wind.

The field of life sciences constitutes the potentially most important research area. In spite of a slight head start of the USA, the sector remains an area with competitive positions still being largely undefined and in which there are no strong differences on the specific technology level. Public support can thus make a real difference, ideally being targeted at the entire sector. Taking into account the relative importance of social-environmental factors, Europe has the potential of occupying a leading role in the future life-sciences scientific field.

Policy Recommendations

To prevent a decline of Europe S&T positioning in the eventuality of a failure of the Lisbon strategy combined with the consolidation of current trends that emphasise economic factors for the support of R&D, the corrective strategies for Europe could include:

- The promotion of public and private partnerships,
- Fostering industrial R&D strategies based on technologies where **potential for leadership** exists in Europe,
- The promotion of **'centres of excellence'** at regional level,
- Development of **research centres** to create the conditions to **attract foreign researchers** in key technologies in which Europe or a majority of European countries needs extra competencies.

1. Additional specific actions - transfer activities, 'trans-national' research and provision of venture-capital should aim at **enhancing the transfer** process management from R&D to application/innovation in Europe. Specific technologies that are very dependant on such links could be targeted. Examples are provided by smart materials, ultra-thin functional coatings, micro-sensors and nano-sensors.

2. Establish a strong industrial European strategy as a basis for an R&D **strategic policy linked with economic issues**. As long as Europe will not have such strategy, R&D targeting on economic issues will depend on national will and national environment and opportunities.

3. Enhance the **participation of SMEs** - which constitute the basis of European industrial environment - in R&D projects. A first step could be to simplify public support procedures today often analysed as 'too bureaucratic, too formalistic, too rigid' or 'complex proposal procedures, slow administrative processes and high administrative expenses', at European level and often at national level.

4. Access of small research intensive companies to **venture capital** should be strongly supported - incentives, organisation, networks, pools - mainly in the field of ICT, Life-Sciences and nanotechnologies. A specific recommendation could be to support at political level the creation of a venture capital line at the European Central Bank.

5. Launch a programme to overcome the significant differences in the views of European countries with regard to technologies that **promote sustainable developments.**

6. Organize some awareness raising campaigns **targeting the public** at large in order to promote a better understanding of the potential applications of some key technologies, such as stem cells or protein engineering.

7. **Support sustainable development know-how** throughout Europe by means of conferences, CD ROMs and other media.

8. **Organize awareness** of the scientists of what happen elsewhere in applications' focused R&D.

9. Promote legal frameworks to to favour the development of R&D on key emerging technologies by:
   - Encouraging national legislation to **facilitate approval** procedures for tissue engineering products,
   - Strengthening legal protection of the European **cultural collections,**
   - **Proposing EU regulations for nanotechnology** and nano-particle use in therapy,
   - Adopting a **clear position at European leve**l on the patenting of human DNA and human stem cells.

10. **Organise networking** between scientific communities to foster convergence: micro-robotic, virtual reality and computer aided surgery, mobile communications and health services, neurology-nano-sensors, neuro-informatics.

11. Use applications' targeted projects to **reinforce convergence:** in domains such as nano-computers, applications of multi-purpose robots and micro-robotics applied to biology.

12. **Facilitate cooperation** between research institutes and very small firms or associations through European Research programs: groups of artists for research in virtual realities, artists and industries, SMEs in FP7.

13. Foster the field of sustainable development in the years to come. It seems necessary to underline that **external costs are real costs**. This needs to be done permanently, on the basis that externalities often have a strong local impact.

14. Face issues at worldwide level. Europe could foster broad **dissemination of results**. In the area of sustainable development, this could take the form of support for R&D projects in which research activities are carried out in Europe and demonstration activities are carried out in developing countries.

15. A strong focus in the public support should **target molecular imaging technologies**. The USA has clearly taken the lead on these. It is of great importance to keep companies' imaging research potential within Europe. Already we can observe the start of a brain drain in this domain.

16. Beyond legal initiatives to encourage national legislators to facilitate approval procedures for **tissue engineering**, there is a real need for clinical and economic studies on this technology. These studies should be included in the EU Framework Programmes.

17. It is necessary to enhance the **GEN-AU** program for **GEN**ome Research in **Au**stria. Mainly to attract researchers back to Europe to work in the human genomes and proteomes field. The same recommendation can also be made for protein engineering through a **European HUPO project** to tackle **HU**man **P**roteome **O**rganisation.

18. It is necessary to ensure **continuity** in the European Union framework programs as biotechnology research needs long-term activities to attract private companies.

Informing the general reflections regarding the structure and content of the 7th Framework Program, the results of the project are likely to have a high level impact on both national and international level.

The detailed findings will be made accessible through the publication of the Final Report which the European Commission is currently preparing.

Selected Sources and References

- AAAS, Preliminary Analysis of R&D in the FY 2006 Budget, February 2005.
- BMBF - Bundesministerium für Bildung und Forschung, January 2005, www.bmbf.de
- CM International - www.cm-intl.com
- Eurostat 2004, Annexe statistique rapport d'activité du CNRS 2002 published in February 2004.
- Ministry of Research, January 2005 - www.recherche.gouv.fr
- 'Science and Innovation Investment Framework 2004-2014', Her Majesty's Treasury, Department of Trade and Industry, Department for Education and Skills, July 2004.
- 'Toward the Year 2030', July 2001, Science and Technology Foresight Center, National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology
- OECD, Main Science and Technology Indicators, Key Figures, November 2004

Youth Foresight Germany 2020

Authors:	Agnes Pechmann / Dialogik / Pechmann@dialogik-expert.de		
Sponsors:	National-level:	Wrigley GmbH BASF Aktiengesellschaft Vodafone D2 GmbH	
	Regional-level:	EnBW AG BASF Aktiengesellschaft Wrigley GmbH Infineon Technologies AG BASF Schwarzheide GmbH Vodafone D2 GmbH	
Type:	Single Issue Foresight		
Organizer:	Geschäftstelle Jugend denkt Zukunft (IFOK GmbH Institute for Organisational Communication) Karmen Strahonja / info@jugend-denkt-zukunft.de		
Duration:	Sept. 2004 +	Budget: N.A.	Time Horizon: 2020

Young People Can Shape Their Future!

'Jugend denkt Zukunft' was setup to make this vision come true and translated directly into English it means 'young people are thinking about their future'. This single issue foresight exercise is designed to involve young adults in the process of economic development. Together with companies, students between the age of 15 and 18 develop new products and services for the world of tomorrow. The main pillar of this program is the nature of co-operation between companies and schools. Further support comes from politics and science. Together they are strong partners for re-creating a culture of innovation.

Re-Creating Germany's Culture of Innovation

If it wants to be 'fit for the future' Germany needs to establish a culture with enthusiasm for innovation. To foster such a culture some basic ingredients are necessary: interest for new ideas, an eagerness to develop them and an urge to try out the new products and services. This can only be achieved through collaboration involving society, politics and the economy. It is therefore important to find new ways to develop visions and create knowledge as a basis for innovation.

The goal of this exercise was to foster such a culture of innovation, a culture of 'get-up-and-do-it' based on the belief that ideas can be realized.

The Innovation Game

The heart of the initiative is a five-day 'innovation game'. In this 'game', students in cooperation with companies develop products and services for the future. The concept, structure and feasibility of the method were tested in the pilot phase in summer 2004. Since then, numerous 'games' have been successfully played.

Over a timeframe of five consecutive days, the participating students simulate an exemplary innovation process that starts with the analysis of global mega trends and identification of industry-specific trends right through to the development and marketing of a new product or a service, the students study and go through the complete process. All of this is condensed to fit into a single week.

The innovation game is prepared, organized and controlled by IFOK — the Institute for Organisational Communication, represented in each game by a professional moderator. The moderator's task is to keep the approach clearly structured.

It is a prerequisite that each innovation game has a clear company sponsor. So far over 180 student groups in classes 9-12, representing students of age 15 to 18, of all school types have been adopted by companies through a sponsorship.

In addition to the sponsors of single innovation games, mentors of various kinds also sign up to support the initiative. These include high ranking federal and state governmental officials as well as representatives of chambers of commerce and numerous foundations have helped out and continue to help in this initiative to evoke a culture of innovation among German youth.

To support the main goal that of creating an innovative culture in Germany several activities are carried out at national level. These include events like a discussion forum involving decision makers in politics and business. They include contests among all participating groups for the best ideas. The best selected ideas receive 'innovation awards'. The activities on the national level are made possible by the three main sponsors of the project Wrigley GmbH, BASF Aktiengesellschaft and Vodafone D2 GmbH.

Another important activity funded by these three sponsors is the continuous enhancement and improvement of the foresight process as a whole.

Method of the Game

One cycle of the innovation game consists of three main phases and five sub-phases. The timeframe for one cycle comprises five conjoint days.

The student group has to pick a topic out of a range of mega trends laid out by the framework of the innovation game and a range of topics related to products and services of the enterprise with which the school co-operates (see diagram below).

Making Mega-Trends Manageable

The innovation game requires the student groups to choose working topics related to general Mega-Trends which apply to society and the economy as a whole and are of relevance to the products and services provided by the sponsoring company. The Mega-Trends covered in the framework of Youth Foresight Germany are:

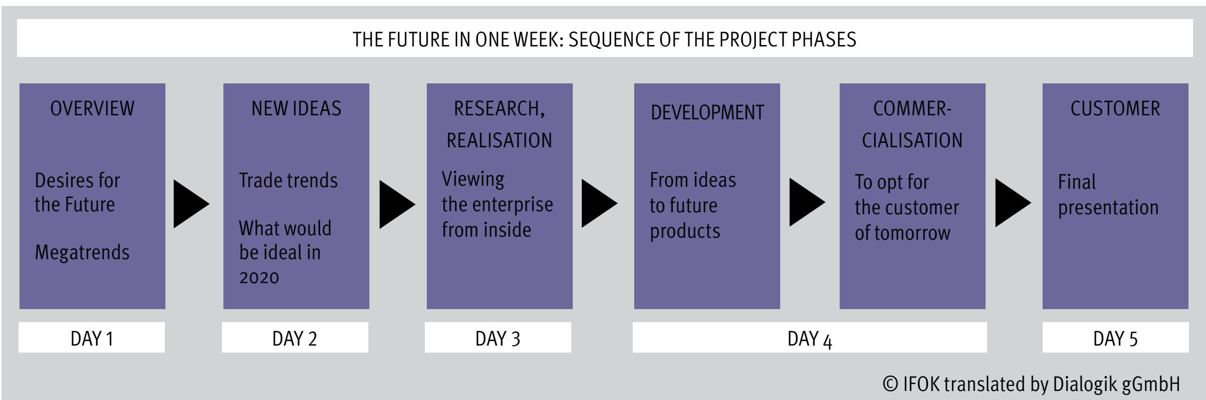
- Lifelong learning,
- Demographic change and the aging society,
- Resource conflict and excessive use of ecological systems,
- Life in the networked world:
    - The use of Information and Communication Technologies,
    - The Knowledge Company,
    - The Information Society, and
    - Globalization.
- New technologies, miniaturization and nanotechnologies,
- Migration, Mobility, Urbanisation, diversity in value systems,
- Climatic change ,
- Humans and economics,
- New epidemics,
- Individualisation and self-responsibility.

These Mega-Trends have been made more manageable by linking them to specific subjects and targets of importance to companies.

So far the student groups have dealt with the following subjects:

- Nutrition,
- Health,
- Pharmaceuticals and the prevention of disease,
- Life-style, Recreation, Vacation and Tourism,
- The Future of the Work Place,
- Services and Consumption of Tomorrow,
    - Financial services of the future,
    - Economics of the future and alternative trading.
- Work life balance,
- Housing and living,
- The Future of Cleaning,
- Living in the year 2020,
- Information, Communication and Digitalization,
    - Sensor Technologies,
    - Media.
- Mobility and Transport,
- New Energy Sources, Alternative use of Resources.

They are required to think about them, not for the point of view of contemporary life but from a perspective set about 15 years in the future. The groups are asked to put themselves into a mindset of 2020 and to find solutions and ideas relevant for living then.



During the five-day 'innovation game' the participants not only get to know the method of the innovation game but learn what it takes to make an idea feasible. They are confronted with the whole chain of innovation, from the first brilliant idea to the market analysis, to the choice of appropriate marketing concept and finally to the development and marketing of the innovative product or service.

A third benefit for the students lies in their development of personal skills and orientations. They learn presentation techniques. They acquire method and process knowledge. They find out how to do research, how to find relevant information and filter it in order to gain orientation for their task.

Young People Becoming Entrepreneurs

Youth Foresight Germany has already had and still continues to have impacts on a number of levels. The following examples are supposed to give an idea how innovation can have an impact on the self-esteem of young people, how it can foster co-operation between different actors in the economy and society and how it changing society by giving its youth the confidence and the courage to create and to innovate. One of the goals was to demonstrate to young people that they are not only able to dream but they are capable of making their dreams come true. The following examples demonstrate the success of the 'innovation game' initiative:

Five female 11th grade students founded their own enterprise called PIA which stands for Produkte im Alltag or Solutions for Daily Life.

Their services focus on mundane chores such as car cleaning, services around the house or in office buildings, as well as babysitting or indeed any other service which can be handled by the five ladies. Advertising is successfully done via word-of-mouth.

Through the 'innovation game' the girls had the idea and found the courage to actually make it happen. Although this is not a new high-tech enterprise it could be the first step towards something bigger in the career of the five young ladies. For sure they have earned valuable practical experience in business management – and all this while continuing their education.

Photo by Dorn - The five ladies of PIA - 'Produkte im Alltag' (Solutions in Daily Life)

Initiating Long-time Co-operation

Youth Foresight Germany is not a one-off exercise. By continuous support for 'innovation games' at every level of schooling and throughout the school year long-time co-operation between the sponsoring companies and the sponsored school can be established.

Since their participation in the 'innovation game' students from one of the participating schools now work for the local newspaper 'Bergsträßer Anzeiger'. They work on a conceptual basis and on editorial issues. At the same time the newspaper co-operates closely with the school especially within the framework of a voluntary working group on 'Media'.

Another effect of cooperation between companies and the schools they sponsor lies in the field of job-offers and applications. Students apply to sponsoring companies for apprenticeships and for other training positions. This is regarded as a very important effect especially at schools for lower-lever education.

Companies Pick up Ideas

The innovation game is a win-win-situation for both main actors:

- The school with their students, and
- The companies who sponsor them.

One example for the company side is the first branch of a bank for young people: 'banking and fun' which was opened as a subsidiary of the Volksbank Rhein-Neckar on 9 February 2006. This subsidiary is a direct result of the innovation game!

The examples given here are only a few out of the very many now available, but they already give a good impression of what initiatives such as 'Youth Foresight Germany' can achieve.

Furthermore, the success of Youth Foresight Germany is underscored by its growth beyond the world of business into other areas of the society. In future new organisations will develop co-operation with school, among them are hospitals, churches, administrations such as Brandenburg with its state chancellery and the municipalities.

Sources and References

This brief has been written based on information available at **www.jugend-denkt-zukunft.de** and based on information provided by IFOK the Institute for Organisational Communication with website at **www.ifok.de**

Foresight for Mobile Radio Spectrum 2020

Authors:	Simon FORGE of SCF Associates / simon.forge@whsmithnet.co.uk
Sponsors:	The IPTS (Institute for Prospective Studies) in Seville The European Commission Directorate General for the Information Society
Type:	International single issue foresight exercise on European spectrum demand up to 2020
Organizer:	SCF Associates Ltd
Duration:	2004 to 2005 / Budget: € 100 000 / Time Horizon: 2020

Purpose

This brief is about a study on the Future Mobile Markets & Services that employed a Foresight approach. The role of the study was to provide a robust and realistic understanding of future demand for radio spectrum for mobile services up to 2020. The first challenge was to create an estimate based on sound socio-economic principles rather than techno-centric wish lists. The next was to achieve European consensus on this understanding so it could be supported by all EU players in international fora such as the ITU based in Geneva. The final goal was to develop and apply a method for estimating demand that could gain the support of and be taken up by the 136+ countries involved in ITU Working Party 8F that is trying to understand demand for services and their markets in preparation for WRC-07 – a World Radio Conference to take place in 2007 at which mobile radio spectrum will be apportioned internationally.

Reorganizing the Radio Spectrum

The 'FMS' study on Future Mobile Markets & Services was triggered by imminent global discussions on the allocation of radio spectrum frequencies that are due to take place under the auspices of the ITU in 2007. Decisions taken at WRC-07 will be of prime importance economically and politically as it is of direct relevance for cellular mobile which by the start of 2006 had already reached over 2 billion users globally (source ITU, March 2006).

The first challenge was to formulate a new method to assess demand within the framework of the current ITU methodology that is based on socio-economics. Traditionally this field had been dominated (perhaps wrongly so) by the technology-driven visions of operators and suppliers rather than by the reality of affordability and the motivation provided by utility to consumers and business users.

A further challenge was to provide a realistic conceptualisation of new types of services through an examination of the business model for innovative mobile services termed 4G or fourth generation mobile. The final major challenge was verification to be carried out through an industry survey on prognostications as well as workshops.

New Approaches to Assess Alternative Trajectories

Major objective was to research and develop a robust methodology, which could start with scenarios of possible alternative trajectories of economic development and go to types of users.

It would then continue right down to minutes of usage of specific services, at specific points in the future. Also it had to give the characteristics of services and traffic in ITU parameter terms. This required the project team to concentrate on a logical series of delivery goals:

- Scenario creation in a formalised and repeatable way,
- Comparison of scenarios,
- Characterisation of users and their uses,
- Identification of future mobile services and their characteristics for spectrum usage (over 130 were specified),
- Projections for the adoption of services,
- Projection over time of traffic volumes,
- Projections of behaviour based on motivation and need,
- Verification of early findings and scenarios with a structured questionnaire and form of Delphi analysis, a major survey exercise of industry experts,
- Analysis of findings of the industry survey,

- Business models for a new type of network architecture envisioned (4G).

The next step was to evangelise the methodology through:
- Identification of key stakeholders and decision points,
- Presentation to key groups such as the European CEPT,
- Public workshops with a large, diverse audience with invitations going out worldwide and invited speakers from Europe and the USA,
- Companion EC projects with a technical focus such as 'Winner' including visits to their workshops.

Surveying the ITU Community

The ITU WP8F questionnaire on spectrum demands and mobile markets sent to its member country delegations provided the basic information on demands, services, spectrum requirements and traffic volumes by service. The overall approach exploited scenario forecasting to show needs and motivations. From these data types of demand against disposable income under the impacts of the various economic scenarios could be identified. This whole methodology was aimed at producing a socio-economic approach to demand forecasting.

Learning from the Failures of the Past

This approach was adopted from the outset for several reasons. Too often techno-centric views of new services have resulted in demand being underestimated or overestimated. Thus, while some major product launches in telecommunications over the past 20 years have turned out to be flops, seemingly trivial services have exploded in significance. The potential of simple messaging service or SMS for instance was completely missed. Whereas WAP - Wireless Access Protocol for mobile web access to rich data services was the subject of great industry hype and overoptimistic forecasts. Today's debacle is the comparative failure of 3G mobile and the staving off of a cheaper successor in the form of 4G.

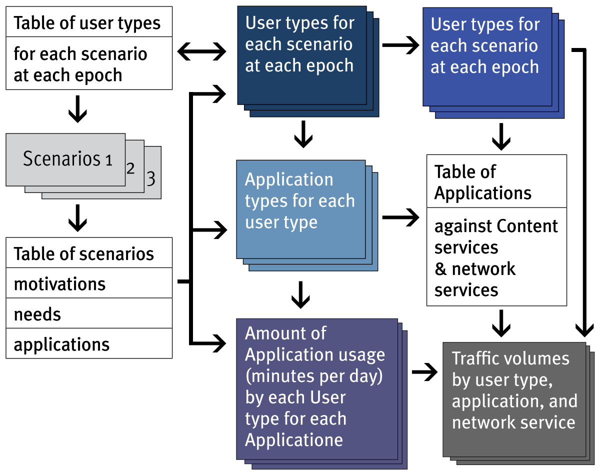
The telecommunications industry has often forgotten a fundamental lesson when bringing a new product or service successfully to market, that the requirement of user needs takes precedence over technology dreams. There is a strong tendency in an industry driven by simplistic marketing to make forward extrapolations from past experience, even ignoring that consumption is determined by levels of disposable income.

Scenarios for Mobile Communication

The scenarios methodology recognised that in the case of wireless services, a regional market such as that of the European Union will be increasingly shaped by global forces. By 2020 there could be as much as five billion mobile users around the world shaping the technology, services, content and pricing. An estimation of all related parameters was carried out for three specific 'epochs' – now until 2010, 2015 and 2020.

The study also recognised a need for the verification of scenarios, firstly by a peer group in a workshop and secondly by a questionnaire survey of telecommunications industry stakeholders, but also economists and sociologists. The peer review led to several major changes and the questionnaire yielded 43 full responses most of which broadly endorsed the scenarios.

To proceed as efficiently as possibly further research was confined to three of the five scenarios – the two extreme disaster scenarios of financial collapse and a major disaster were discarded leaving:
- An **Optimistic** scenario economically,
- **Stagnation** of the economy in Europe, and
- A **Changing** scenario with pockets of prosperity and high migration to growth clusters of high tech industry.



For these three scenarios a detailed analysis was carried out on the motivations, needs and applications of different user types.

User profile tables were drawn up by age-group, income-group and epoch for the aggregated population of the EU. A key premise was that motivations drive needs from which services and usage levels can be determined. The overall method is summarised in the diagram above.

In addition to the organizers of FMS study various other stakeholder organisations were involved:
- **The CEPT** - a telecommunications industry body for Europe for standards and policy.
- **The ITU** - the global industry body under whose auspices discussion for spectrum allocation will take place in 2007.
- **National Delegation**s for spectrum regulation worldwide who participated in the study.

- **The IPTS** of Spain who commissioned the study and managed it on behalf of the Information Society spectrum group.
- **The Information Society Spectrum Group**.
- The European **RSPG** or Radio Spectrum Policy Group.

Demand for Mobile Communication in the Developing World

Take-up across Europe will vary greatly with the economic scenario, both in terms of level of usage and type of service in demand. A major future growth area for mobile telephony however will be the developing world. It will influence the EU and the OECD community in mobile products and services. Globally the demand for mobile applications and services will vary according to the EU profile with different levels of traffic placing different demands on the spectrum.

It was recognised at the outset that forecasting future demand meant that a much better understanding was needed of who would use mobile services, what they might want to use them for, how much they might want to use them and most importantly how much they could afford to pay for them.

A key point was that consumer and business segments would be much more educated in creating a lifestyle around advanced services. The game boys and girls of today will become the 'game people' of tomorrow - technophobia or lack of IT literacy will be less of a barrier than it is today. Key motivations were found to differ substantially across scenarios.

Ambitions decline with earnings. People turn inwards, retiring to a more basic and rural existence as the grey and green economies substitute for the normal monetary economy. Technology needs are minimised.

For the constant change scenario, survival in a situation of economic instability, both positive and negative, and continual migration to new clusters is the motivation. Long term, the scenario may be gently optimistic, needs are for autonomy, to find work and control a changing lifestyle while supporting local and remote families.

Changing Service Patterns

The project found a wide range of services that could be brought to market. It identified over 130 services that could be classified under headings such as Lifestyle, Entertainment, Communications and Business Applications (More detail is available in documents from the FMS website)

Results for traffic growth between 2010 and 2015 show little difference between scenarios. **The Smooth Development** and constant **Change scenarios** show almost identical steady growth and there is real but gradual decline in traffic in the case of **Economic Stagnation**. It is only after 2015 that the big differences in traffic volumes become apparent.

Growth in traffic under the constant **Change scenario** is much more marked than in economic stagnation, as expected, growing four-fold between 2010 and 2015. However this is dwarfed by the **Smooth Development** scenario, where traffic grows almost nine times in the five year period. By 2020 there will be 8 times more traffic in the constant **Change scenario** compared with **Economic Stagnation**, and 15 times more than in the **Smooth Development** scenario, but most change will take place after 2015.

Growth in the **Smooth** and **Change scenarios** arises from different sources. In the **Smooth Development** scenario the huge growth in traffic comes from individual consumers, whereas in the **Change scenario**, growth from individual consumers is more steady, most of the growth resulting from increased use by enterprise. In the **Stagnation scenario**, consumer traffic is very limited indeed and almost all of the traffic results from enterprise use.

In terms of sectoral trends, the most important and least examined facet is the market analysis in terms of real customers and their real needs. On the basis of the scenarios user-profiles were developed with specific segmentations for consumer and business users. In consequence, the main segmentation could be described as two user-types as follows:

Consumers: These were analysed using segmentation in terms of age and income. The user population in each scenario was largely differentiated by disposable income and general economic outlook. In the **Smooth Development** scenario (the most prosperous case) we saw a widening of the middle class at all levels (upper, middle, lower) as the scenario progressed so that those at or beneath the poverty line reduced in number. By contrast the **Economic Stagnation** scenario swells the lower brackets with an expanding population at or below the poverty line, and more people in the lower earnings segment, with migration of upper middle class to lower middle class. In the **Change scenario**, we expect expansion of a lower middle class which is largely migrant, while there is a tendency for the lowest income segments to reduce in number as the scenario progresses.

Business users: These were divided by size of enterprise. The willingness of an enterprise to purchase changed in marked fashion from one scenario to another but the dominance of the micro enterprise (less than 10 staff) and the continued rise of the small and medium enterprise was notable with the big differences arising in the decline of the formal business community and its purchasing power in the **Economic Stagnation** scenario.

Responding to the Needs of Certain User Groups

In the **smooth development** scenario, needs drive opportunities for education and retraining applications, as well as lifestyle organisational applications. These respond to the need for self-improvement in a busy lifestyle, especially for women who become the major consumers of mobile services of all kinds, be it self-restocking of the fridge to handling a job, children and relationships. In complete contrast, the economic **stagnation** scenario drives very simple applications aimed more at survival, so that voice and SMS are increasingly important. New services innovate by lowering costs (e.g. Voice-SMS) rather than by introducing new technical features and plain vanilla services rule. Constant **change** requires quite different applications. Need drives a requirement to support migrant families and workers who must constantly stay in touch across the world at low cost, while maintaining continuity and accessibility in lifestyle services such as banking and shopping. Mobile services substitute for presence. Retraining occurs on the move and at low cost in response to constant pressure to update skills in a competitive job market in a knowledge-based society. Such requirements might need new low cost services and specific technical advances such as display technologies for self teaching, or projection from the handset or other terminal device. Consequently, the next stage of usage of radio services will most probably be oriented towards a range of ubiquitous applications, perhaps never seen before, that enhance lifestyles with supporting services and entertainment. The scenario work suggests a new era beyond the basic communications of voice and SMS.

Avoiding the Techno-Centric View

The key lessons for research policy are:

- Avoid the use of techno-centric estimates for demand for consumer services, such as mobile and its spectrum requirements. Use instead a socio-economic analytic basis, grounded on disposable income and economic scenarios.
- Be wary in of vendors driving very high bit rates R&D policy and in regulatory spectrum policy making. As the 3G technology experience has shown they often cannot deliver these as easily as they claim.
- Move beyond the idea that one spectrum band equates to one service - the future is perhaps about 4G mobile technologies able to share spectrum.

The FMS study formulated the following recommendations:

- Examine market demand for technology not the technology itself,
- Do so in terms of users motivation and needs analysis,
- Use scenario approaches here.

New Requirements for Shared Spectrum

The only key area requiring immediate active consideration is perhaps the area of spectrum regulation where new models of shared spectrum with expansion of the common unlicensed bands are perhaps in need of expansion so as to encourage the development of Alternative Wireless Technologies.

The Relativity of Foresight Results

There is a temptation to consider calculations performed in the course of a Foresight study as predictions of the future. This temptation should be resisted. They are at best reasonable estimates of mobile traffic based on the assumptions and conditions of each scenario.

Perhaps the most critical issue to bear in mind when interpreting levels of final traffic, service and user type, the results presented in the FMS study are based on a great many assumptions and approximations.

Sources and References

- The complete FMS study can be accessed at the FMS website http://fms.jrc.es which contains all working reports, workshop presentations, study reports and the major appendixes.
- The main report is also published by IPTS (Institute of Prospective Technological Studies), DG JRC/EC, Sevilla, Spain, as a bound report EUR 21673, Forge, S., Blackman, C., & Bohlin, E., The demand for future mobile markets and services in Europe, ISBN 92-79-00099-3.
- ITU WP8F documents are only available to member country delegates, although it may be possible that certain summaries may be made available on application, to the ITU WP8F working party, in Geneva.
- 'Is fourth generation mobile nirvana.....or nothing?' Forge, S. (2004) Info, Vol. 6 (1).
- Forge, S., Blackman, C. & Bohlin, E. (2006). Constructing and using scenarios to forecast demand for future mobile communications services. Foresight, Vol. 8 (3).

UNIDO Technology Foresight Initiative

Authors:	Sami Mahroum / ARC Systems Research / sami.mahroum@arcs.ac.at
Sponsors:	UNIDO National Governments
Type:	A global initiative that draws on and supplements national and regional TF initiatives.
Organizer:	UNIDO along with the ministries of the various participating countries that deal with national economic and industrial development
Duration:	Ongoing since 1996 / Budget: N.A. / Time Horizon: +20 years

A Global Initiative on Technology Foresight

UNIDO is implementing a global initiative on Technology Foresight. This draws upon regional initiatives and aims at building the capability to use Technology Foresight as a practical tool for designing policies and strategies to exploit critical and emerging technologies for the benefit of developing countries and economies in transition.

Supporting Industrial Progress in Developing Countries

The UNIDO TF or 'Technology Foresight' Programme focuses on industrial development issues. In doing so it intends to assist developing countries to upgrade their industrial sectors from resource-based to technology-based capacity in order to better integrate their products in the regional or global economy.

National TF exercises would be packaged whenever possible into regional initiatives in order to enable cost effectiveness of preparatory and common awareness building and training activities together with networking arrangements.

The regional dimension of UNIDO TF initiatives help less developed or small countries to be more aware of global and regional trends which could provide advantages or pose challenges to their economies.

Finding National Competitive Advantage

The goal of UNIDO TF regional initiatives is to help developing countries, involved in or seeking to be involved in Technology Foresight to move ahead at regional level by building on national exercises already in progress. In practical terms the UNIDO TF initiative seeks to achieve the following:

- Identify conducive policy frameworks.
- Strengthen interaction, communication and cooperation between all relevant stakeholders of the national innovation system.
- Facilitate decision makers in identifying priority areas in selected industrial sectors of national competitive advantage to enable the national products and services to better access the regional and the global market.
- Build capacity at institutional and enterprise level to identify risks and opportunities on how to improve value chain competitiveness through the application and use of technology foresight analysis and methodologies.
- Establish a knowledge-based network related to national technology foresight initiatives, programs and activities in order to make available for reference at regional level sources of information, studies, expertise and comparisons.

In addition to achieving the expected benefits of a TF exercise, the UNIDO TF initiative aims at helping developing countries overcome potential difficulties and reduce excessive costs associated with the realization of full-scale technology foresight exercises at national level.

Methodology and Approach

Currently UNIDO is carrying out regional initiatives in Latin America, in Central and Eastern Europe countries and in the Newly Independent States of the Former Soviet Union – the so called CEE/NIS countries. Various approaches and methodologies are being employed depending on the type of activity. In NIS and Eastern European countries, UNIDO TF activities revolved around awareness building, capacity building, regional foresight and the development of a center for regional knowledge exchange.

In multi-country foresight exercises as conducted in Latin America the methodology can be summarized as the follows:

- Major technological trends are identified at a global level,

- Technologies or technological sectors of specific importance at regional level are identified and selected.
- Finally the results of national TF exercises help reveal the amount and type of work needed to match the challenges.
- The aforementioned technological and organizational infrastructures provide a platform for such exercises of analysis and reflection.
- All participating countries in ongoing initiatives are part of a so-called **'dynamic foresight regional network'**. This network is supported by an information technology infrastructure that aids and facilitates the exchange of knowledge.

Foresight in Latin America

Technology Foresight activities in this region started in 1996. A programme to support national foresight initiatives was implemented from 1999 on the basis of financing provided by Italian authorities through the ICS or International Center for Science and High Technology, based in Trieste. ICS funding supported activities in Brazil, Chile, Uruguay and Venezuela until the first quarter of 2002.

In **Chile** a Delphi exercise was completed to identify strategic economic and technology sectors over a ten-year period. The Chilean TF Programme started in 2001 and is now a component of the National Programme on Innovation and Technology Development. It gets co-funding from the IDB or Inter-American Bank. In effect the UNIDO contribution provided the seed money to launch the Chilean TF programme and mobilize the necessary extra funding.

In **Brazil**, according to UNIDO, a methodological approach for industrial technology foresight was developed to address the needs of industrial production chains. TF exercises were concluded for three production chains:

- Textiles and Garments,
- Plastics, and
- Wooded Furniture.

In **Uruguay** the national technology foresight programme was conducted within a framework established between UNIDO and the Secretary of President of the Republic with the support of its National Council for Science and Technology. This foresight exercise focused on the most important economic sectors in terms of actual and prospective contribution to GNP. It aimed at addressing regional and international scenarios and factors which would influence the Uruguayan economy over a fifteen-year period. In 2002 the study phase was concluded for the following three macro-sectors:

- Food biotechnology,
- Energy, as well as
- Transportation and Logistics.

In **Venezuela**, UNIDO and the ICS provided support for TF activities managed by the Ministry for science and Technology. An example of such an activity was the 'Yucca in Gondola Agricultural Project'. An important aim was to apply the results of TF in the definition of policies and strategies for up-grading the technological capacity of selected industries in the country.

Technology Fair of the Future

In cooperation with UNCTAD, UNIDO organized and conducted a 'Technology Fair of the Future' on 13-18 June 2004 in São Paulo Brazil, as part of the UNCTAD XI General Conference. The Fair was financed by UNIDO and the Governments of Austria and Brazil. A total of 97 technology firms and institutions from 15 countries made use of the fair facilities and presented a wide range of innovative technologies in:

- Agro-food,
- Energy,
- ICT,
- Biotechnology,
- Aerospace,
- Materials,
- Electronics and nano-technology, as well as
- Innovation Support Services.

This involved 202 persons. Most of these were researchers, innovators, technology managers or CEOs of companies who attended the fair and participated in the discussions and meetings at different fair events.

Using Technology Foresight for Production Chains

UNIDO helped in the development of a new concept for the use of TF for production chains. A first study was carried out with support from the Spanish government and focused on a multi-country production chain related to the fishing industry in the Pacific Coast of South America. The results were presented in a regional conference on 5-6 May 2005 in Manta, Ecuador.

Engagement in Central and Eastern Europe and NIS

Since 2001, UNIDO has been implementing the 'Regional Initiative for Technology Foresight' in the countries of the CEE (Central and Eastern Europe) and the NIS (Newly Independent States of the former Soviet Union).

This regional initiative aims at responding to the Central and Eastern Europe and NIS need for a mid- and long-term development vision of the region, as well as for bringing a more technology-oriented focus into the relevant national and regional knowledge-based institutions.

The initiative enjoys strong support from several countries. Reports indicates that it has received funding contributions from Austria, Czech Republic, Hungary, Slovakia, Turkey, Russian Federation, the United Kingdom and Ukraine.

Awareness Building Towards a Foresight Culture

UNIDO and the Hungarian Government have decided to establish a regular Technology Foresight Summit. The first summit took place in March 2003 in Budapest and its thematic highlight was the field of biotechnology. As one of the components of the summit, UNIDO launched a new activity - the 'Technology Fair of the Future'. Awareness building of the importance of Technology Foresight as a decision-making tool for long term strategy was further promoted through an international conference on 'New Advances of Technology Foresight' which took place in Kiev, Ukraine on 10-11 September 2002.

Capacity Building

To date UNIDO provides training at four distinct levels:

- **Module 1:** Basic training for organizers of foresight programmes
- **Module 2:** Methodology for practitioners
- **Module 3:** Instruments for strategy and policy for decision makers
- **Module 4:** Corporate Foresight

Altogether approximately 300 professionals from 28 countries have been trained through the above mentioned exercises.

In 2004 additional training seminars at national level were organized in Kiev, Ukraine and in Sofia-Bulgaria in order to build and strengthen capabilities for the national exercises.

UNIDO is in the process of establishing a distance-learning programme on Technology Foresight at the Ukrainian Centre of Distance Education at the Kiev Polytechnic Institute.

UNIDO has also developed a manual on Technology Foresight.

The Regional Virtual Centre as Facilitator

In 2005 UNIDO, in cooperation with the governments of the Czech Republic and Hungary launched the organization of a 'regional virtual center' to facilitate the implementation of the Regional Initiative on Technology Foresight for the CEE/NIS.

The regional virtual center is conceived as a network of institutions and persons working in the field of Technology Foresight. It makes intensive use of modern information and communication technologies. It comprises one central unit and a series of selected focal points.

The intended participants and beneficiaries of the network are high level decision makers from policy institutions, officials and managers responsible for technology development in the countries of the CEE/NIS and other selected regions, as well as decision makers of enterprises working in these regions.

Foresight now a part of UNIDO Initiatives

An independent evaluation of the impact of the various UNIDO activities in Technology foresight is not available. Nevertheless UNIDO continues to support activities that are deemed successful and useful by its clients. According to UNIDO, at the 25th session of the Industrial Development Board its member countries acknowledged the successful implementation of the 'Regional Initiative for CEE/NIS' and this lead to a recognition by the member countries that comparative advantage could be gained by promoting Technology Foresight in the framework of the organization's regional programmes and initiatives. Technology Foresight therefore continues to be included among the new UNIDO initiatives.

The results of capacity building efforts have been deemed very encouraging by UNIDO. They are seen by the organisation as a pillar for the creation and improvement of national and regional Foresight processes and studies.

The aim of the programme is not only to deliver a finished package of assistance but also to establish a continuous and systematic instrument for advising governments and industrial actors about Technology Foresight and its implementation.

Sources and References

- Miyake, T. UNIDO Technology Foresight Programme & Business Incubation.
- Technology Foresight Initiative for Latin America and the Caribbean countries: Spanish contribution. A 'PROJECT DOCUMENT'.
- Dr. Ricardo Seidl Da Fonseca, TF Programme manager at UNIDO.

See the website at:

- **www.unido.org/foresight**

Canada Looking Forward S+T 21C

Authors:	Diane A. Isabelle / diane.isabelle@nrc.gc.ca		
Sponsors:	National Research Council of Canada		
Type:	Global foresight exercise		
Organizer:	National Research Council of Canada		
Duration:	2005	Budget: € 350 000	Time Horizon: 2020

Purpose

The NRC or National Research Council of Canada undertook a foresight exercise with a time horizon of 2020 to initiate planning for its strategic and organizational renewal. The exercise provided a global perspective and critical insights on the future and impact of S+T in Canada, and on opportunities for the NRC to address national challenges as part of the Canadian National System of Innovation.

NRC - Science at Work for Canada

The NRC is the Government of Canada's highest body for national research and development. It stimulates community-based innovation and is an active player in international research collaboration that helps to extend Canada's knowledge creation networks and influence in vital sectors on a domestic and global level. The mandate of the NRC is to foster the scientific development of Canadian industry in response to Canadian needs, and for the extension and expansion of Canadian trade both at home and abroad.

The Drivers of the NRC

The renewal project intended to identify opportunities and to address a number of fundamental pressures and strategic issues that have emerged in the evolution of the NRC. In particular it sought opportunities to enhance the impact of NRC activities on Canadian socio-economic well-being and stimulate transformative changes within the National System of Innovation. This requires the NRC to re-assess its key roles and extend its core capabilities to further enable commercialization and align NRC resources and investments with Federal Government priorities.

The 'Renewal Project'

The 'Renewal Project' is composed of four distinct phases:

- Phase I: Environmental Scan.
- Phase II: Strategic Direction.
- Phase III: Strategy Development.
- Phase IV: Strategy Implementation.

Phases I and II are now completed and Phase III will soon to be finalized. The environmental scan involved identifying global issues that were societal, economic or scientific in nature, industry needs and government priorities as well as S+T trends that will shape research and science in Canada over the coming years. It included an assessment of NRC core competencies, an analysis of the Canadian national system of innovation, and interviews with selected Canadian and foreign government S&T organizations on needs in relation to organizational capabilities. More specifically, five teams composed of internal researchers and external consultants were formed to conduct the environmental scan and the core competency assessment of NRC. A variety of techniques were used such as organization-wide participatory actions, extensive literature search, brainstorming and consultations, surveys, interviews, S+T foresight workshops and scenario-building exercises. The process also involved consultation with internal and external stakeholders. A consolidation exercise was followed by an exploration of possible futures and impacts via a scenario-building exercise. A 'Strategy and Priorities Committee' led by a senior executive oversaw and guided the iterative process, while a project management team structured what was in effect a complex and rather novel initiative for the NRC.

Findings of the Environmental Scan

The main findings are as follows:

- **Changes in Cultural Identity:** By 2025 it is expected that roughly 22% of the Canadian population will be aged 65 and over. By then Canada's population is expected to be around 35 million with visible minorities accounting for 19% to 23% of the total. Between 6.3 and 8.5 million citizens will reflect cultures, values and religions that are quite different from those upon which the country was founded. Demographic change will have economic and social impact in terms of a smaller workforce, lower productivity, pension payment liability, changing consumer expectations and increased demands on natural resources.

- **Worldwide Decline of the Nation State:** Although democracy is on the rise there is also a growing number of failed nation-states. The nation-state is seen to be losing ground to trade and religious groupings as the primary source of identity and Canada's place in the world will decline.
- **Loss of Leadership by Western Society:** In the 20th century it was widely assumed that the future would be owned and defined by western industrial cultures, technologies, economies and world views. Shifts in the way we think about the world contribute to a loss of confidence in institutions and leadership in western society.
- **Demand for Greater Security:** Rapidly increasing global interdependence brings new threats and vulnerabilities. The ability of the state to deal with the privatization of conflict weakens. To some extent 'security' drives how we perceive the world and how we react within it.

From this backdrop several challenges of critical importance for Canada and the world have been identified.

Chronic Diseases and an Aging Population: Chronic disease is the most common and costly health problem worldwide. Chronic diseases must be addressed to ensure quality of life for an aging population. Opportunities exist in the area of early diagnosis, monitoring and cures for many of these diseases based on Canadian strengths in genomics, proteomics, biosensors, biomaterials and nanotechnology areas.

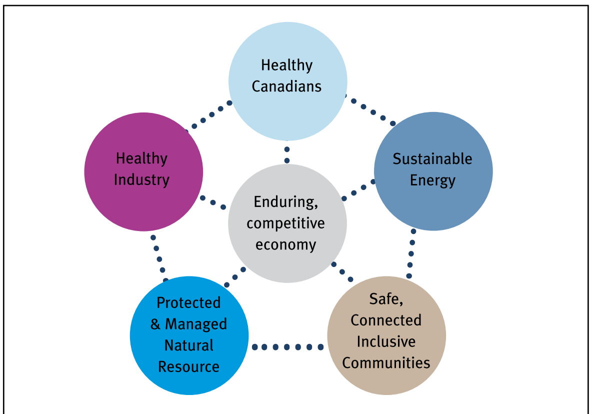
Pandemics and Infectious Diseases: Bacteria and viruses are able to develop resistance to essentially all antimicrobial and antiviral agents marketed to date. With population movement at an all-time high, conditions are ideal for the global transmission of infection. There is need for quick identification of infectious agents, for the creation of a robust, innovative production capacity for vaccines. Traditionally the vaccine market was unattractive to investors but the economics of vaccines may be improving, particularly with countries now scrambling to stockpile vaccines. Canada has responded with the creation of the 'Public Health Agency of Canada' and is viewed as one of the countries better prepared for a pandemic.

Natural Resource R&D: In all challenges that were examined, the Canadian resource sectors, including agri-food, forests, energy, minerals and metals, as well as related industries are some of the largest contributors to our GDP. While there are many S&T players involved in these sectors, they, for the most part, concentrate on the early stages of the value chain and on development of markets; the goals are primarily sustainability, efficiency and marketability. This is one of the sectors in which there is clearly an urgent need for R&D, particularly in innovative value-added opportunities such as **Agrifood**, where it is likely that developed countries will achieve the goal of producing sufficient quantities and qualities of value-added agri-food products to have a significant positive impact on their economies within the next 10 years. In the area of **Forestry** Canada has proven its ability to be innovative and with the right combination of R&D and policy frameworks it should not only maintain its global position but improve upon it. The **Mining and Minerals** industry is well positioned to transform S+T advances into commercial activity. It fully appreciates both the commercial and environmental imperatives for its leadership role in sustainable development. The likelihood of achieving significant benefits is therefore very high. Canada is rich in **fresh water resources** whereas freshwater is becoming increasingly scarce around the world. Canada should seize the challenge and become a world leader in all related domains - purification, desalination, transportation of water; and safe water management through the application of technology.

Environmentally Sound Technologies: The emerging global market for environmental technologies presents a significant economic opportunity for Canada. This refers to all technologies to manage pollution through control, remediation, avoidance and monitoring. According to OECD findings **bio-based technologies** will provide both economic and environmental benefits that include cost savings of 10-50%, a reduction of CO_2 emissions by 10- 80%, water savings of 20-50% and a significant reduction in pollution and toxic substances. In Canada, a combination of abundant biomass resources, a strong science base for industrial bioproducts and bioenergy, and federal priorities in favour of biotechnology, are creating a favourable climate for the development of a **new bioproducts** and **bioprocessing industry.** Canada is recognized as a **world leader in bio-fuel**. Reducing the cost of technologies and systems for biomass harvesting and conversion into bioproducts and bioenergy is therefore a major R&D target.

Sustainable Energy and Economic Growth: Access to adequate supplies of energy is both an opportunity and a pre-requisite for growth. Although the potential benefits of **hydrogen and fuel cells** are significant, many challenges remain before they will offer a competitive energy alternative. Cost and storage are the biggest challenges. Research is needed to develop storage technologies using materials such as metal hydrides and carbon nanostructures. **Solar and wind** are renewable energy sources that offer more than just a solution to meet our growing energy needs and address oil depletion and climate change problems. They also create new opportunities for economic growth and provide security benefits. Solar and wind energy will also accelerate the transition to reliance upon domestically available clean energy technologies. There is a renewed interest in **nuclear power** as an emission-free energy source and as a natural hedge against the environmental costs of fossil fuels. Uranium is one of the world's most important energy minerals, but is notable for its very low energy efficiency. Less than 1% of the resource is extracted as energy and the rest is stored as 'waste'. At this rate, Canadian uranium resources, about 14% of world total, will be exhausted within 50 years. R&D is required to make that technology 10 to 50 times more efficient. The oceans contain a huge amount of power that can be exploited for generating useful energy. Developed conversion systems concern tidal energy, thermal energy, marine currents and **ocean waves**. Canada is particularly rich in tidal current and wave energy resources.

Connected Communities both from a physical and virtual perspective will create new opportunities for many sectors of society, including transportation, trade, education, research, healthcare as well as security and government services. Connecting communities requires physical infrastructure for transportation, transportation technologies, network infrastructure, computational power, bandwidth, as well as software and hardware technologies to address the challenge. This connectivity is essential to support the new knowledge economy. While the Canadian economy is generally quite sound with growth maintained at roughly 2.7% in 2005 and forecast growth of 3.1% and increased employment for 2006, some factors of **Canadian competitiveness** are a cause for concern. Canada has dropped in economic performance and global competitiveness, productivity is lagging and the global balance of economic power is shifting to emerging giants such as China and India.



The previous graphic highlights S&T opportunity themes identified from the foresight study and validated with extensive consultations. These themes are interconnected and progress in one theme will almost certainly affect others. Most importantly these themes take into account the economy, society and the environment in an integrated way that provides the foundation for sustainable development.

Phase II— Strategic direction (June -December 2005)

Armed with the consolidated findings and insights from the environmental scan several activities took place ;

Internal perspective on opportunities for NRC:

A series of 26 workshops were held with NRC staff across the country from August to October 2005. Staff was asked for input on the key opportunities and challenges identified for NRC. The opportunities highlighted by staff were consistent with those identified in the foresight phase as key national issues: energy, natural resources and health.

External stakeholders' consultations

In September and October 2005, 7 cross-country workshops with close to 300 key external stakeholders from industry, universities, and provincial and municipal government organizations were conducted. The objectives of these consultations were to build a shared understanding of the S&T opportunities and challenges for Canada from the perspective of the year 2020, and assess whether a strong role can be played by NRC. The consultation process was critical because NRC's selection of strategic directions rests, in large part, on its ability to engage its key stakeholders. The tables below outline the opportunities and challenges.

Opportunities				
Protected & Managed Natural Resources	Healthy Canadians	Sustainable Energy	Healthy Industry	Connected, safe, inclusive communities
Protection	Wellness	Efficiency	Materials	Transportation
Management	Public Health	Clean energy	Manufacturing	Emergency Preparedness
Conservation	Prevention	Conservation	Commercialization	Connectivity - Communications
Monitoring	Diagnosis	Alternatives	Productivity	Security
Modeling	Drugs & Therapies			
Water, Minerals, Oceans, Forest	Age related diseases	Distributed systems	Efficiency	Housing E-economy
	Chronic diseases			
	Individualized medicine			

Several potential roles for NRC were derived.

Disruptive technologies workshop

On November 2005, over 40 scientists from across NRC got together for a unique brainstorming session. The goal was to build on extensive study on anticipations of S&T to 2020 and identify areas of S&T likely to be transformed by breakthroughs in the next generation and in which the NRC should consider investing in competency development.

Challenges				
Governance	Infrastructure	Knowledge/ IP Management	Education	HQP
National S&T Policy linked to economy	Focus on regional strengths	Approach for knowledge sharing, management & distribution	Cross-disciplinary education	Ability to attract & retain top talent
Aligning government priorities	Smart regulations	Access to international knowledge	Engagement of aboriginal youth	Ability to grow internal talent
Better collaborations between government, academia & industry	Increasing private sector research/ receptor capacity	Value added to products before export	Professors with industry experience	Industry receptor capacity
Leadership	Adaptive, responsive, agile system	Protection of IP for Canada	Immigration policy linked to education needs	Immigration policies linked to employment opportunities

The results of the exercise are summarized here:

Disruptive technologies most likely to happen, and in which NRC should invest in competency development	
Human health Diagnostics Therapeutics Bio-systems interfaces Food	**ICT** Mathematical theory of computation Programming languages Software engineering Breakthrough applications New software authoring communities
Transportation Autonomous vehicles Micro-vehicles Sub-orbital vehicles	
Intelligent systems Manufacturing Monitoring environments Infrastructure	
Quantum technologies Cryptography and computing Photonics, spintronics and molecular electronics Extreme meas. and control	**Sustainable energy and environment** Generation Storage and distribution Energy user technology

Impact and Policy Implications

As a result of these foresight studies and consultations on challenges, opportunities and disruptive technologies, the Senior Executive and members of the Strategy and Priorities Committee are working to develop a new strategy for the NRC, identifying its purpose, role, vision and goals to contribute to increasing Canada's social and economic competitiveness into the future.

Sources and References

The consolidation report entitled 'Looking Forward: S&T for the 21st century' can be found at the following website: http://www.nrc-cnrc.gc.ca/docs/NRC-Foresight_Consolidation_Report_e.pdf

Quebec S+T Development Based on Social Needs

Authors:	Alain Bergeron / alain.bergeron@cst.gouv.qc.ca Geneviève Drolet / genevieve.drolet@mdeie.gouv.qc.ca Original texts tranlsated by Anne McBryde		
Sponsors:	MEDIE - The Ministry of Economic Development, Innovation and Exportation of Quebec VRQ - Valorisation Recherche Québec CST - The Council for Science and Technology of Quebec		
Type:	A National S+T Foresight Exercise		
Organizer:	Alain Bergeron at the CST		
Duration:	2003-2007	Budget: € 1.2M	Time Horizon: 2020

Science-Technology-Society Perspectives

The STS Perspectives project is a foresight study examining Science-Technology-Society issues, designed to mobilize Quebec's scientific and technological resources in order to address important socio-economic challenges that Quebec society will face over the course of the next 15 to 20 years. This project started in 2003 and is still ongoing.

Bridging the Gap Between Science, Technology and Society

The Council for Science and Technology is greatly concerned about how to bridge the gap between science, technology and Quebec society. This issue is very important because science and technology must be integrated in a more decisive and harmonious manner into all areas and sectors of society, if Quebec is to become a real knowledge-based society.

An attempt to bridge the gap must be made by stakeholders on all sides of the science-technology-society system through a dialogue taking place on a regular basis. Not only does Quebec society have to master scientific and technological knowledge and methodology to a greater extent in all its sectors of activity, but stakeholders from the areas of science and technology need to pay more heed to the concerns of members of society, most notably as regards the orientation of their work and its impact. Criteria for R & D funding must therefore be such that they take social needs into account.

The **STS Perspectives** project is an attempt to directly addresses this challenge. It proposes to ask people to identify the main socio-economic challenges that Quebec society will have to face in the future and then in conjunction with scientists, provide direction efforts in research and innovation. In the sense that few of the world's foresight projects have focused on S+T demand rather than on its supply, **STS Perspectives** is a truly innovative undertaking.

Raising Awareness and Increasing Societal Involvement

The three main objectives of the **STS Perspectives** project are to:

- Raise awareness in all sectors of Quebec society as to the importance and usefulness of science and technology for understanding and resolving socio-economic problems,
- Invite the scientific community of Quebec to participate in the process of achieving social and economic goals through the application of science and technology, and
- Mobilize the partners involved in Quebec's socio-economic development, including those from the area of scientific and technological development, to determine the main challenges that Quebec society will have to face in the next few years, and to formulate the strategies required to meet those challenges.

Defining the Societal Challenges

The project includes two main phases. The first consists of a four stage Foresight study and the second phase builds on that with an emphasis on strategic planning.

Phase I of the project consists in outlining a certain number of recognized major socio-economic challenges that generate needs for new knowledge and new technology or innovation. It involves **four stages**:

Stage I: Consulting with the Quebois in order to establish the main issues of concern regarding the future and learning about their perceptions of the main socio-economic problems that Quebec will have to face over the course of the next two decades. In the fall of 2003 6 **discussion groups** were assembled in various regions of Quebec so that members could express their views on this subject. A **questionnaire** was created using information gathered from these groups in order to better identify the issues of concern to people, regarding the changes that could affect Quebec society over the next twenty years. Finally a **telephone survey** was carried out involving 1,623 residents of Quebec aged 15 and older.

Stage II: Foresight workshops brought together about one hundred participants from a wide range of backgrounds, representing various sectors of Quebec society. The theme of this workshop was 'Building the Future' and it was held in October 2004. The 104 participants were selected for their original ideas, their capacity to work in groups, their originality, their creativity, their social involvement and their ability to develop a certain foresight-related vision of Quebec. They were required to create a list of 40 major socio-economic challenges that Quebec will face in the next 20 years. As food for thought the participants were provided with a first summary of the results of the Stage I survey.

Stage III: In an attempt to reduce the list established previously to fewer than 10 or so challenges, a **consultation was then held with members of the Quebec scientific community** to take account of contributions that could be expected from science and technology. The list of 40 challenges was submitted to Quebec researchers during an on-line consultation conducted at the beginning of 2005. In all 1,306 researchers from university, industry, government and other circles, participated in the consultation process. More than 50 percent of respondents chose 7 of the 40 challenges.

Stage IV: The **drafting of** seven **thematic reports** by seven specialized committees, formulating and explaining the challenges and their potential science-technology components. These reports were drafted with help from about 60 experts. They presented an overview of the main fields of research which could help to address the seven challenges. They provided examples of research themes, and the range of scientific and technological disciplines concerned.

Main Results of Phase I: People's Concerns

Consulting the general public in Phase I of the Foresight project has allowed the organizers to better understand the main issues of concern for the Quebecois regarding the future.

Education and 'public access to knowledge' was an important issues for people, yet at the same time they viewed these matters from a very optimistic angle. **Environmental questions** also turned out to be very important for respondents, but in this case they were much less optimistic as to how these issues would unfold. This was especially true mong young people. The majority of respondents in fact did not believe that the main pollution problems would be solved within the next 20 years.

People are less concerned about the economy as they are about the environment. Nevertheless their concern about the economy was greater than their concern about access to knowledge. A large percentage of respondents, most notably the poorest and least educated among them, are worried about the impacts of **globalization** on Quebec, in particlar on the employment situation.

People are most concerned with **individual well-being**. The strongest predictions that we recorded concerning future deterioration involve the quality of family life, individual physical and psychological health, as well as the quality of the environment.

Above and beyond these important realities the Quebecois believe that Quebec society will become increasingly multicultural in nature, that the French language will declikne and that at the same time the province will find itself ncreasingly in the grip of American culture.

Finally, people do not view the theme of politics in a very positive light. They insist rather pessimistically, that the government will not manage to solve problems related to the deficit and the provincial debt.

The 40 Challenges Identified

In stage 2 of the foresight workshop, 40 main socio-economic challenges that Quebec society will have to face in the near future were identified. They can be grouped into 6 thematic categories. Without being exhaustive these are as follows:

- **Health and Life-Style:** The public health-care system, quality of life of senior citizens, nutrition, well-being, sports and leisure.
- **The Environment and Resources:** Natural-resource development, water management, green energy, transportation, waste production and fossil energy.
- **The Economy, Research and Innovation:** Priorities involving research, globalization, the solidarity economy, high value added jobs, agriculture, networks, the regions of Quebec and a highly qualified workforce.
- **Education:** Learning languages, teaching science, school drop-out and teaching in underprivileged environments.

- **Demographics and Communities:** The increasing the birth rate, immigration, and issues related to specific groups such as the First Nation people and the Inuit.
- **Culture and Society:** Public participation in the democratic process, making science accessible to society, ethical considerations, reconciliation of work with family life, poverty and culture.

Main Socio-Economic Challenges

The consultation process involving researchers in Stage III of Phase I made it possible to identify seven major socio-economic challenges where research could improve our understanding of the real problems that lie behind each challenge and provide insight into how they could be tackled. The seven challenges are as follows:

- Promote the adoption of **healthy life-styles**, based on a preventive holistic vision of physical and psychological health and on efforts to make people responsible for their own health.
- Increase **the efficiency of the public health-care system** that must support an gradually aging society while at the same time controlling costs.
- Develop **natural resources** and manage waste more efficiently using a **sustainable-development** approach to the point that Quebec becomes a world leader in this area.
- Provide **high-quality education** that combines rigour, creativity, flexibility and responsible citizenship, and that is accessible to all.
- Target **strategic and priority market niches** in the areas of research, economic development and education, on the basis of current strengths and emerging sectors.
- Reduce dependence on fossil energy and make Quebec a leader in the fields of **energy efficiency** and **renewable energy**, mass transit and new environmental technologies.
- Adopt **innovative interventions for controlling povert**y and the factors that generate and maintain it, so as to stave off the consequences of poverty such as marginalisation and a sense of powerlessness as well as inequity and violence.

Research Funding as Main Priority

Besides determining the seven challenges, the researchers questioned during Stage III of the Phase I were asked to comment on scientific and technological development prospects for Quebec. Research funding was chosen by 76% of respondents as being one of the three most important challenges to be met over the next 10 years in order to promote the scientific and technological development of Quebec. The other outstanding challenges include knowledge transfer (35%), maintaining a balance between independent research and targeted research (33%), increasing private funding for research (22.7%), and promoting scientific careers among young people (17%).

Multi-disciplinary Fields, Centred on Transfer and Sustainable Development

In the Stage IV of Phase I each of the seven selected challenges was presented to a group of experts charged with explaining the key related issues and suggesting the main fields of research that could help in meeting these challenges. The multidisciplinary character of the fields provided important links among the challenges. All challenges involve two important types of contributions from research:

- Understanding the challenge, and
- Developing and integrating innovation in practice.

The solutions to the problems raised by the seven challenges are inevitably rely on public intervention. Furthermore, the work groups have pointed out the necessity of integrating each challenge within a sustainable development perspective.

Follow-Up on 'STS Perspectives'

Phase II of the project began in the fall of 2005. This this Phase the Council for Science and Technology intends to ensure that research development strategies will be designed and implemented for each of the seven challenges chosen in Phase I. These strategies will take a long term view. They will take into account the major evolutionary trends within the scientifc fields targeted by the challenges in question.

A steering committee will be formed for each of the seven challenges. Each committee will be made up of five researchers and five representatives from research-result user communities.

The Council prefers to set the focus on questions such as:

- Which research themes have to be developed first in order to help meet the challenges?
- What resources will be needed?
- How can the transfer and exchange of knowledge between the researchers and users be ensured?
- How can exchanges and sustainable collaboration among the researchers from the various areas and disciplines be promoted?

Partnerships

The **STS Perspectives project** enjoys the support of a number of collaborators and partners. The main sponsors were:

- **MEDIE:** The Ministry of Economic Development, Innovation and Exportation, and
- VRQ: Valorisation Recherche Québec.

The project also enjoyed the active support of:

- **ACFAS:** Association francophone pour le savoir
- **ADRIQ:** Association des directeurs de la recherche industrielle du Québec
- **FQRNT:** The 'Fonds québécois de la recherche sur la nature et les technologies'
- **FQRSC:** The 'Fonds québécois de la recherche sur la société et la culture'
- **FRSQ:** The 'Fonds de la recherche en santé du Québec'.

Several other ministries and agencies were involved in the execution of Phase II.

Agreements have already been reached with the ministries and agencies that have specific responsibilities linked to the challenges in question. For example The Ministry of Health and Social Services is especially active on Challenges 1 and 2, The Ministry of Natural Resources, Wildlife and Parks is deeply involved in Challenges 3 and 6, while The Ministry of Employment and Social Solidarity is mainly concerned with Challenges 4 and 7.

The three Quebec grant providers were:

- **FQRSC:** The Quebec Research Fund on Society and Culture,
- **FQRNT:** The Quebec Research Fund on Nature and Technology, and
- **FRSQ:** The Research Fund on Health in Quebec.

In June 2005 they form a partnership with the Council to follow-up on the results of the Foresight. The Research & Development strategies for each of the seven challenges should emerge towards the end of 2006 and throughout 2007.

Cross-Sectoral Collaboration

The **STS Perspectives** project offers the ministries and agencies affected by the challenges in question, the possibility of better orienting and planning their research and innovation initiatives. The three Quebec grant providers have already integrated the **STS Perspectives** challenges into their strategic planning.

To help better understand and find solutions for some of the main challenges that Quebec must address over the next 20 years, strategies will be developed based on collaboration among government interveners, research-sector stakeholders and research users. This exercise is the first of its kind to be carried out for Quebec.

Conclusion

The **STS Perspectives** project constitutes a first use of foresight research as a means of providing food for thought for decision-makers concerning the future of research, science and technology in Quebec. Besides assisting the decision-making process, this project reflects upon the ways in which the general public can participate in key decision making in the future. It is expected that this Foresight-related thinking will continue, and will create other spin-off benefits in the years ahead.

Sources and References

The project website is available at:
http://www.cst.gouv.qc.ca/LE-PROJET-PERSPECTIVES-Science,384

2020 Living in a Networked World Individually and Securely

Authors:	Werner Reutter / werner.reutter@rz.hu-berlin.de		
Sponsors:	Federal Ministry of Education and Research		
Type:	Part of the national foresight process – covering all S&T fields, as well as social and individual effects of technological developments		
Organizer:	IFOK – The Institut für Organisation und Kommunikation as consortium leader, in cooperation with Fraunhofer ISI IZT VDI/VDE-IT and Pixelpark		
Duration:	2002-2005	Budget: N.A.	Time Horizon: 2020

Needs and Prospects for Individuals in a Networked World

Our public, private and professional lives will become interrelated and dependent on technology. This will lead to a 'networked world' in which separate technologies will be systematically interconnected and adjusted to specific and individual needs. The Lead Vision of the German Futur initiative 'Living in a networked world: individually and securely' is based on an exploration of possible trajectories for these developments that take account of how the dual process of networking – networking between technologies as well as networking between human beings and machines – can be politically shaped and directed.

Lead Visions as a Way to Define R&D Priorities

The Lead Vision 'Living in a networked world: individually and securely' is party of the offspring of the German Research Dialogue: Futur. This dialogue was initiated by the German Federal Ministry of Education and Research and managed by IFOK. Through this research dialogue the Ministry tried to identify crucial topics for future research and public funding by an open, participatory approach. Four Lead Visions have already been identified. Apart from the Lead Vision presented in this Brief these were:

- 'Smart Web',
- 'Understanding Thought Processes', and
- 'Healthy and Vital throughout Life by Prevention'.

These visions provide signposts to guide research and help deal with the technological and social challenges to come.

More than 1500 experts participated in this programme so far; 1000 experts engaged in discussions on the Lead Vision: 'Living in a networked world: individually and securely'.

The Personalized World of Interaction Goals and Prospects

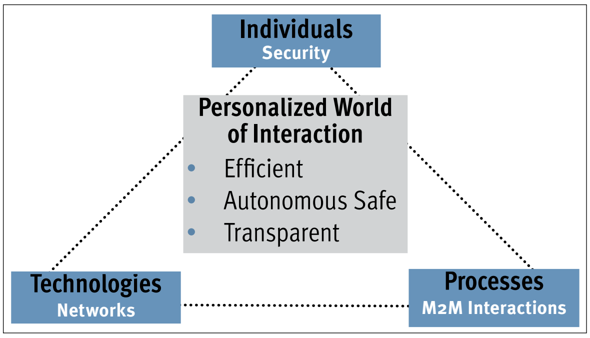
The development and invention of new technologies – notably Information and Communication Technologies – already have affected our private, public and professional lives immensely. Until now we mostly use technologies such as mobile phones and computers, separately and independently from each other. What is still not adequately addressed however,, is the fact that these technologies will become more and more interconnected. This will trigger a triple process.

The different spheres of our lives will become increasingly intermeshed and intertwined. The existing boundaries between our private, public, and professional lives will disappear. This will require technologies that can transgress limits. They have to be interconnected and turned into networks. In order to meet the social and individual demands these networks have to be ubiquitous. They have to be accessible at any time, from any place, and in any situation. In short, we will live in a networked world. Finally, these technologies have to comply with our personal needs and wishes. This pre-supposes a highly developed level of M2M-interaction and communication.

The aforementioned prospects define two primary goals of the Lead Vision:

- First, the Lead Vision wants to help to develop a digital network that meets the needs of their users. Autonomy and individuality of the users are crucial requirements that are to prevail over technical requirements. It is not the user that is to adapt to the technology but the technology to the users.

- Second, the Lead Vision endeavours to feature a technology that is in any sense reliable. The technological infrastructure will be invisible as well as accessible at any time. In addition, bi-directional information should be possible.



The Three Dimensions of this 'Personalized World of Interaction'

Overall, these developments will lead to a 'personalized world of interaction' that:

- Guarantees the security of its members,
- Provides their members with a ubiquitous technological infrastructure, and
- Allows M2M-interaction.

That is process-oriented, able to learn, develop and adjust.

The outcome of the foresight process was that in a 'personalised world of interaction' the users will remain embedded in their social-cultural environment. The networked world will not create 'monadic' isolated individuals but will foster and sustain social networks. The networked world will serve a socially, professionally, and culturally active population. This Lead Vision points towards an interdisciplinary approach. It strives to combine concepts from the social sciences and cultural studies with research into new technologies.

Social and Economic Dimensions of the Networked World

According to the Lead Vision, the networked world will alter our life fundamentally. Networked systems will not just be tools to accomplish specific tasks. They will support our daily lives on an individual and personal basis. They will relieve us from routine tasks and fulfil encompassing functions.

The Lead Vision identified long-term trends that will determine the shape and the extent of the 'personalised world of interaction':

- Social and technical systems will become far more complex. In order to deal with this complexity individuals as well as the society in general will need assistance provided by the networks themselves. In addition, the technical systems have to be transparent and foster the autonomy of the users. The users have to be able to manage their environments in a flexible and self-determined way.
- Globalisation will bring about more communication and mobility. The networked world will have to provide us with the technological infrastructure in order to use these options in the best way.
- In the networked world intellectual property rights will become more important. We will have to think about how to protect these rights without undermining the positive effects of the network systems. 'Open Sourcing' and new modes of organisation will have to be established in order to secure these rights.
- This personalised world of interaction will be part of a society of knowledge. Lifelong learning will be a must for everybody.

On the other hand, the networked world has not only to comply with individual needs but also to guarantee other properties: it has to provide confidentiality, authenticity, and transparency as well as reliability and security.

The development of these technologies will help to create new jobs and strengthen Germany's competitiveness in the world market. They will solve social problems and lead to the creation of new and highly qualified jobs.

Methodology

The German Research Dialogue: Futur was organized in a participatory, bottom-up approach that included conferences, workshops and focus groups. Even though it was an open-ended process, it still found consensus on a number of issues and provided guidelines for future research and policy.

What is true in general for Futur is true in particular for the Lead Vision **Living in a Networked World: Individually and Securely.**

Further Fields of Research

Technical Research

The Lead Vision has affected existing research and triggered new questions relating to: M2M-interaction, embedded systems, software agents, networks, the structure of services, and security.

Until now **M2M-interaction** is mostly based on the screen-keyboard-mouse principle. However recent developments in artificial intelligence and in micro-system technologies may provide new solutions and new modes for man-machine interaction. Relevant fields for future research in this area include communication, visualisation, sensor-technologies and energy supply.

- As far as **communication** is concerned the main problem is how to translate spoken words into a semantic model. Put another way, we need technologies that can understand what has been said and act upon this understanding. This line of research is still in its infancy.
- As far as **visualisation** is concerned a number of improvements already have been made. Simulation-techniques are used in a variety of fields such as augmented-reality-applications and virtual engineering. In addition to this new materials may one day lead to the use of flexible displays and intelligent reusable 'intelligent paper'.
- New **sensor-technologies** have also been developed. These enable interface techniques managed by head- or eye-movements, puffing etc. These techniques will facilitate future M2M-interaction. Other technologies will help both man and machine to better understand information as well as the situations that users may find themselves in.
- **Energy** is mostly supplied to devices using conventional batteries. Future research will explore new ways for providing energy to mobile devices using muscle movements for example.
- Finally new technologies will have to take into account how fast individual users can learn. This will determine the level of **support** that systems will have to provide.
- **Embedded Systems:** Already many tasks in everyday life are delegated to 'embedded systems' that guide the technical systems of cars, airplanes and buildings. Research is required on how existing technologies may be put into practice and further integrated with existing and future systems.
- **Software Agents:** By contrast with 'embedded systems' 'software agents' are autonomous. They are not embedded in other technologies. Software agents are like robots in that they may interact with other software agents on behalf of users. This raises a number of questions concerning interactions not only between software agents but between individuals and software agents. It raises questions about the legal consequences of these interactions such as 'who is liable if something goes wrong when a software agent acts on one's behalf?
- **Networks and structure of services:** Global communication systems such as networks for television and broadcasting will interact with mobile and body area networks attached to individual users. The first steps in this direction have already have been made. Video on demand and multimedia messaging are just early examples of such services.
- **Security:** A pivotal problem is to protect private and professional communication. This implies a need for cryptographic research as well as answers to questions such as how the sender of a message can definitely be identified. Even though technologies based on Public Key Infrastructure, digital signatures, biometrical identification and technologies for digital rights management are already in use, they lack practicability. They are inefficient and costly. Further basic research on security aspects is required.

Non-Technical and Interdisciplinary Research

Apart from all these issues that refer to the technological side of a networked world, the Lead Vision also addresses non-technical and interdisciplinary factors of the innovations being considered. First and foremost a networked world can only work if there are common policies, as well as technical rules and standards. This concerns legal issues such as copyright and other rights such as the right to encrypt messages and monetary issues such as the availability of micro-payment systems, and issues such as protection of private data. Finally, the personalized world of interaction will have social, political, and cultural ramifications which will require interdisciplinary research to understand.

Implementation

The Ministry of Education already has started to act upon the guidelines laid out in the Lead Vision. Apart from programs such as Mikrosystemtechnik 2000+ that address specific issues, but which were not specifically designed for and triggered by this Lead Vision, a number of new dedicated projects are already being carried out.

As a first measure the Ministry of Education and Research set up the **Verisoft** project. This initiative will develop safety-standards for Information Technologies. It will roll-out over an eight year period from 2003 until 2011 and has so far received €7.2M. It is lead by the University Saarland, administered by the Deutsche Zentrum für Luft- und Raumfahrt and is being carried out in cooperation with the Technical Universities in Darmstadt, Karlsruhe and Munich as well as with the German Research Centre for Artificial Intelligence and the Max-Planck-Institute in Saarbrücken. Industrial partners include Infineon Technologies, T-Systems Nova, BMW and Absint.

Another project entitled **SicAri** started in October 2003. It is funded for four years with €5.3M and will develop a software-package that allows safe IT-communication.
MIND a third project funded by the ministry with €2.4M tries to improve computer and network security. MIND signifies 'Machine Learning for Intrusion Detection' and the aim is to identify as quickly as possibly any attempt to compromise an IT system made by an internal or external intruder. This project is being carried out by the Fraunhofer First institute, Intelligent Data Analysis, Siemens Corporate Technology, and IT Service Omikron.

Finally, the project SmartWeb will develop software able to comprehend the content of sentences and answer questions. This work will last from 2004 to 2007. The goal is to lay the foundation for multimodal user interfaces to distributed and composable semantic Web services on mobile devices. It has received €13.7M. The academic partners are the DFKI as consortium leader with Fraunhofer Gesellschaft, FIRST, ICSI, and universities from Erlangen, Karlsruhe, Munich, Saarbrücken and Stuttgart. The industrial partners are BMW, DaimlerChrysler, Deutsche Telekom, Siemens, EML, Ontoprise, and Sympalog.

Conclusion and Policy Implications

This Foresight initiative has had a significant impact on the policy agenda of the Federal Ministry of Education and Research. As a result of this Foresight initiative new projects have been set up and are already being carried out. The Lead Vision technique can therefore be considered a success story with regard to the methods and impact of the Foresight approach.

So far the policy implications are one-sided though. Even though the Lead Vision strongly indicated the need for interdisciplinary research, the projects funded by the Ministry are mainly technology oriented. Social, economic, or cultural aspects of technological development are not yet addressed and are not yet reflected in projects supported by the ministry. Important issues such as demographic effects and the fact that we are living in a socially and culturally heterogeneous society are not yet being considered.

Sources and References

www.futur.de
www.verisoft.de
ida.first.fhg.de/projects/mind/mind_official/index.html
smartweb.dfki.de/eng/infotext_en.html

Achieving an Ethical Future for Biomedical R+D

Authors:	Hugo Thenint, Louis Lengrand & Associés / hugo@ll-a.fr The IAF - Institute for Alternative Futures/ futurist@altfutures.com		
Sponsors:	Pfizer Global Research & Development		
Type:	Thematic Foresight on Biomedical R+D on genomics, proteomics, nanotechnology and bioinformatics covered from a global perspective, notably through eastern and western philosophies and practices.		
Organizer:	The IAF - Institute for Alternative Futures in Virginia, USA		
Duration:	2004-2006	Budget: N.A.	Time Horizon: 2029

Purpose

The 2029 Project: Achieving an Ethical Future for Biomedical R+D launched by the IAF - Institute for Alternative Futures develops forecasts on the greatest advances that will come about through biomedical R+D in the next few decades. Short, medium and long-term developments in biomedical R+D are anticipated along with related social and cultural trends. The work refers to the time–periods 2005-2010, 2011-2019 and 2020-2029. The last phase of 'The 2029 Project' focuses on the dissemination of project outputs and on recommendations as to how science and ethics will interact in the creation and discovery of new biomedical knowledge.

The Boundaries of Optimism and the Projection of the Advisable

The emergence of new fields of research, such as genomics, proteomics, nanotechnology or bioinformatics, coupled with knowledge exchanges made possible by the internet are likely to boost our fundamental knowledge of disease processes and provide biomedical R+D with a variety of new research tools.

Policy makers and the general public underestimate rather than overestimate the future contributions that biomedical R+D can make to health care. This project therefore looks at what research and development might achieve over the next 25 years and challenges the conservative view.

The 2029 Project studies the future of biomedical research and development with selected leaders across scientific disciplines that appear particularly relevant to biomedical R+D. The stated objective is to identify the most important developments that could contribute to improving global health by 2029 as well as to draw public attention to the potential contribution of science to public health in the coming years.

The last phase of the project is focused on the dissemination of the project's findings. Information showing the potential of biomedical R+D should provide a useful framework for scientific planning as well as for public debate on research funding as well as on the cost of innovation in healthcare.

Underlying the project objectives is the idea that forecasts can influence the future path of science and catalyze cultural and societal adaptation to technological change.

A Focus on Dialogue and Flexibility

The 2029 Project is based on an interactive approach involving a project core team and a range of scientists, consultants and medical stakeholders. The project is based on an evolutionary and flexible approach where feedback from experts is central to the projects methodology.

By scanning the literature the IAF first produced an initial mapping of thematic R+D areas to guide its research and serve as a reference throughout the project. The team has set categories in science where interdisciplinary connections are operating. It held an initial review of the research framework and identified an initial set of developments likely to foster biomedical research and global health. This map was first used to collect, update and draft fourteen forecasts for key thematic areas identified through the R+D mapping process.

These forecasts were reviewed internally and by key advisors before the preparation of a final draft. The draft formed the starting point for discussions with the designated key Advisers.

IAF also organised a joint meeting with the Draper Laboratory, on the 15 November 2004 to explore the initial forecasts.

Having produced a draft report the IAF held a meeting on 11 February 2005 designed to bring leading scientists into discussions focused on future developments and their possible translation into mid-term opportunities. The focus of discussions has progressively moved from science to ethics and from the notion of disease to the notion of opportunity for health. Since this meeting the project has brought on board these expert contributions and a new section has been added to the final report entitled Evolution of Ethics and Healthcare.

Finally the IAF team concentrated on anticipating short-term (2005-2010), mid-term (2011-2020) and long-term (2021-2029) developments in biomedical R+D. Each of these timelines were characterised by and qualified on the basis of four themes:

- Turning data into information, knowledge and wisdom,
- The union between Eastern and Western philosophies and practices,
- Moving beyond boundaries,
- The shift from disease to health potential.

The main participants in the project were selected for their individual expertise. Interviews and meetings involved scientists from private companies and some from US public organisations. The targeted organisations include:

- Pfizer.
- Draper Laboratory.
- Johnson & Johnson.
- Center for Integration of Medicine and Innovative Technology.
- GE Healthcare.
- University of California at San Francisco Centre for Drug Development.
- Ohio State University.
- U.S. Food and Drug Administration.
- Massachusetts Institute of Technology.

Biomedical R+D Changing Healthcare Practices

Futurists anticipate dramatic changes and an emerging concern with the ethical dimension of global health that will enhance biomedical R+D developments. Subsequent technological breakthroughs will have a great impact on healthcare.

Combining Eastern & Western Philosophies of Health

Researchers are progressively working with new tools which enable to quickly proceed, understand, and place into context torrents of new data and information. By 2010 the combination of open source networks and successes against some global pandemics should rapidly create and spread knowledge around the world.

As a result, a promising global traffic in ideas should bring East and West closer together in scientific understanding. China, India, Japan, Korea and Singapore are likely to generate a growing number of scientists who will take leadership in nanotechnology, stem cell research and bioinformatics. Eastern worldviews coming to biomedical R+D should also foster research into subtle effects that draw upon areas such as chaos theory and an understanding of the body's energy fields.

On the other hand Europe and the U.S. will have an increasing number of scientists studying Asian health concepts and health improvement methods. Ongoing studies of the mind have already demonstrated that eastern meditation techniques can alter emotional states and enhance mental health. Traditional understanding of energy forces based on concepts such as 'chi' can explain physiological phenomenon such as cardiovascular rhythms. Eastern philosophies and practices will continue to be adopted by a growing number of Western educated citizens through the adoption of Yoga, Tai Chi and various other martial art and healing traditions.

Cultural and Ethical Changes

Considering the current trend for pushing cultural boundaries and for the development of global knowledge, it is argued that Western culture could move away from its historical emphasis on the individual, towards a community-based and a collective consciousness. Reciprocally, Eastern culture could move away from its traditional emphasis of cultural harmony towards a growing appeal for individual expression and accomplishment.

When looking at short term ethical concerns, it first appears that self-interested national or regional policies may prevail with hazardous global outcomes. As observed with nuclear proliferation, when technological innovations emerge, the process becomes almost impossible to stop as stakeholders in the global community hasten to occupy vacant niches. This process may already be emerging in the area of stem cell research.

Concerning in particular the development of morally debatable technologies, it can only diminish when a global agreement aims to stop the expansion of these technologies and global enforcement regimes are enacted to ensure such an agreement.

In the long-run, the close interconnection of economic and political systems in a transparent environment of knowledge exchange will encourage the development of a global ethic for biomedical activities. Complete connectivity between researchers, politics and the population who actively collaborate in science will reinforce this need for global ethic.

The project foresees that by 2029 ethical concerns will be clearly integrated in new intellectual property rules negotiated to speed innovation and diffusion. An ethical commitment will expand knowledge access so that the whole world, including the poor, benefit from biomedical R+D. Increases in the economic wellbeing of developing population centres in India and China will foster this evolution. By 2029, well established ethical conventions will frame law and economics as never before. Only then will science and technology accomplish its promise to deliver global health.

Some Potential Breakthroughs

According to the IAF team, four specific advances hold the greatest breakthrough potential, creating new hope for patients and new challenges for healthcare systems:

- **Stem Cells** hold the potential for decisively addressing heart disease, diabetes, cancer and neurological diseases such as Alzheimer's and Parkinson's.
- **Gene Therapy and Gene Silencing Therapeutics** are emerging as new delivery technologies to target specific cells. A number of Eastern countries are pursuing this promising technology. If scientists can understand the complexity of cellular systems there is great potential for the application of RNAi (ribonucleic acid interference) drugs to many diseases.
- **Nano-medicine** has achieved initial success in medical devices and diagnostic tests, but a far larger number of applications could come about within the coming decade. Nanotechnology is bringing valuable research tools and clinically useful devices. A breakthrough could come from implantable devices that diagnose, deliver therapies and monitor effects.
- **Implants and Drug Delivery** devices will improve dramatically as new advances in micro-electromechanical systems (MEMS), nanotechnology and other technologies are combined to create new ways of delivering drugs that improve patient care and mobility.

Towards a Healthcare Approach Based on Prediction and Prevention

While more diseases are overcome, interest in prevention and health potential will grow. Change is about to start with regulators accepting the validity of surrogate markers and suites of wearable biomarkers. Individuals will use these biomarkers for continuous risk monitoring. As more people learn to interpret biological signals, prevention will prevail. By the 2020s, a prognostic system will emerge and begin to replace former diagnostic systems.

The ability to continually monitor individuals and create personal risk assessments will lead to more **tailored therapies.** Risk statements are based upon cellular, tissue and organ system measurements along with behavioural assessments and environmental monitors. To fully understand health risks, research will have to shift from studies of individuals and populations to learning about communities and ecosystems.

The project plans that by 2029, an **Electronic Medical Record** that gathers all Personal Health Records (managed by individuals) from around the world will be implemented. The vast array of available genomic and phenotypic data will help characterize the diversity of populations and supports surveillance for new health threats that emerge.

In this view, IAF experts devised a knowledge interface mediating human's interactions with healthcare system: the **Health Advocate Avatar** (Avatar refers to a Sanskrit term recalling the incarnation of a Hindu God). The system uses natural language processing to present complex medical information in a clear and intuitive way and allows choosing the best possible care.

Users continuously feed data into the Avatar through monitors, used either continuously or periodically. The Health Advocate Avatar would track purchases and other evidence of lifestyle choices, while monitors would show multiple physiological parameters, such as pulse and calories expended during the day.

The interface, linked to global health records will draw upon the cumulative experience of others with similar needs, wants and values to guide decisions and provide incentives that encourage healthy behaviours. As it connects to sources of knowledge for individuals, it also contributes knowledge needed for the collective health of society. For example, the Avatar could pick up signals showing health trends, such as obesity or depression.

However, the Health Advocate Avatar would operate under ethical constraints designed to ensure that it communicates the best available knowledge back to individuals. This way, the Avatar has to be secure and discreet. It has to protect privacy and keep users interests to the fore.

Evolution of Healthcare Systems

According to the 2029 Project new biomedical technologies and preventive healthcare techniques will generate new ways of assessing risks and sharing them amongst communities.

Until now debates on healthcare have focused on the responsibility of the community in financing and delivering healthcare services. In Europe single payer systems have been implemented in order to distribute health risk across the member nations of the European Union. In the United States, the health insurance industry has evolved by distributing health risk across designated social units such as corporations.

As a shift from a disease model of healthcare to a model based on 'health potential' is likely to occur, the distribution of risk and ethical obligation will change too. Both systems need an effective ethical agreement between individuals and social units. Individuals will have a positive moral obligation to maintain their own health and prevent risks over which they have control such as lifestyle factors. For health risks over which the individual has no control, for example health risks with a genetic origin, social units will have a moral obligation to provide.

A potential evolution underlined by the project is that, without such an agreement, healthcare systems could naturally shift back to private care models because there will be no benefit, either moral or economic for the pooling of risk to create viable affordable healthcare systems.

How to Reach an Advisable Biomedical R+D

As part of the last phase of the project, the IAF proposes seven steps to promote the most ethical advances from biomedical R+D, to expand knowledge of health and disease, and to improve health for everyone. These are as follows:

- **Set a goal for adoption by the UN of a minimum health standard for all:** Such a goal could be both an ethical position and a strategy for global political and economic development.
- **Promote Individual Healthcare Responsibility:** Create personalized risk profiles that integrate the collective understanding of health and disease. Individuals and society should use these profiles to encourage individual responsibility for health and collective agreements about resource limits on healthcare.
- **Initiate a global discussion of ethical positions for intellectual property:** Ethical policies can be engineered for greater speed of diffusion while prompting innovation. Intellectual property must work so that innovation offers promise to both the rich and the poor.
- **Move from healthcare focused on the treatment of disease to healthcare that promotes health:** This needs to be accompanied by a new understanding of why people choose behaviours that they do. As a consequence, lifestyle, mental states and the environment should be recognized as integral to the health of citizens.
- **Change healthcare regulations to promote information sharing and new methods beyond clinical trials:** A partnership between research subjects and the biomedical research community should form around new methods that serve individual as well as collective interests.
- **Foster an open-source system for health research, including drug discovery:** An open source system for health research can break down the barriers between organizations and scientific disciplines to create higher quality drug candidates.
- **Create a collaboration of stakeholders to design and develop the Health Advocate Avatar:** The Avatar represents an incredible leap beyond existing strategies to empower patients, transform research and development and promote an ethical system of healthcare.

Sources and References

The 2029 Project: Achieving an Ethical Future in Biomedical R+D by the Institute for Alternative Futures, Alexandria, Virginia, 2005, © the Institute for Alternative Futures. http://www.altfutures.com.

Knowledge Society Foresight

Authors:	Arturs Puga / arturs_puga@yahoo.com
Sponsors:	EUROPEAN FOUNDATION FOR THE IMPROVEMENT OF LIVING AND WORKING CONDITIONS
Project manager:	Timo Kauppinen Timo.Kauppinen@eurofound.eu.int
Type:	European Union coverage of issues of the knowledge based society designed as a vision by the Lisbon objectives
Organizer:	PREST (coordinator), the University of Manchester , UK : Denis Loveridge: denis.loveridge@mbs.ac.uk ; Ian Miles Ian.Miles@man.ac.uk ; Rafael Popper Rafael.Popper@man.ac.uk ; ATLANTIS Consulting S.A., Thessaloniki, Greece: Effie Amanatidou amanatidou@atlantisresearch.gr ; EMPIRICA GmbH, Bonn, Germany: Werner Korte Werner.Korte@empirica.com ; FINLAND FUTURES RESEARCH CENTRE: Jari Kaivo-Oja Jari.Kaivo-oja@tukkk.fi .
Duration:	2001-2004	Budget: N.A.	Time Horizon: 2015

Purpose

Knowledge Society Foresight Euforia was a developmental project aimed at identifying and understanding issues and developments of 'knowledge society' (KS) at the level of EU15 as a whole, and it also exercised the emergence of a KS in three countries representing different paths: Finland, Germany and Greece. Outputs should be applied to assess implications of a KS for areas of living conditions, working conditions and industrial relations. New ways of organising, designing and managing foresight activities were to be explored.

Innovative Approach to Foresight

In 2000, a vision of the European Knowledge Society was provided by the Lisbon Objectives: a dynamic and most competitive knowledge economy with social inclusion, better and high job creation and sustainable development.
In this year the European Foundation for the Improvement of Living and Working Conditions (a tripartite EU body, whose role is to provide key actors in social policy making with findings, knowledge and advice drawn from comparative research) organised two workshops related to the emerging KS and its influence on areas of central concern to the Foundation.

In 2001, within the context of its four-year work programme 'Analysing and anticipating change to support socio-economic progress 2001-2004' the Foundation undertook the foresight project on the 'European Knowledge Society and its influence on living conditions, working conditions and industrial relations'. Two contracts were designed, and implemented in Europe. The first aimed at producing a Handbook on Knowledge Society Foresight (HKSF). The second contract was to (1) test foresight methods in practice, (2) set up three national foresight points, (3) produce indicator analysis on advancement of KS, (4) find KS drivers, (5) analyse the drivers' impacts on living conditions, working conditions and industrial relations in EU15 countries by 2015.

The three-phased project (2001-2004) was designed also to provide support to the European Commission's DG Research and DG Information Society through the production of a methodology and exploring new ways of testing foresight exercises, and guiding these processes towards politically relevant issues. The project also has close links with the work of DG Employment and Social Affairs. European Foresight has emerged as a new and challenging area within the ERA, but attitude of European institutions and national governments, of S&T policy makers toward this strategic policy intelligence instrument / research process still seems to be cautious and in the process of defining a position. The Euforia project had to be a 'pioneer' to demonstrate the effectiveness of the Foresight process performing the research in a multi-cultural and cross-regional setting and providing relevant to the Lisbon strategy policy orientations.

Looking at Knowledge Societies

An Advisory Committee for the project was set up by the European Foundation. The project was coordinated and led by PREST at the University of Manchester, and the process was jointly managed with project partners in Finland (FFRC), Germany (Empirica) and Greece (Atlantis). The Office of Taoiseach (Prime Minister) of Ireland actively took part in the Foundation's project implementation. The project activities involved scientists, researchers and policy-makers from a total of 25 countries (18 European and 7 non-European countries). The pilot countries were selected on the basis of a preliminary set of indicators (of information society development, compiled for the SIBIS project) - Finland (high on most indicators), Germany (roughly average within the EU on most) and Greece (relatively low on most). Partner organisations in each country were recruited to run the national case studies. Different stakeholders from the private, public, research, and NGO sectors provided inputs, and collectively produced outputs achieving objectives of a set of KS oriented foresight exercises.

'Soft' and 'Hard' Methods Combined

The methodological framework indicates to three main processes in Euforia. The first one was related to the scanning activities; the second focused on the analysis of data and outcomes, and the third dealt with final reports performed on basis of the various activities executed during the project. 10 foresight methods were used in the project. The 'soft' ones: Environmental scanning, cross-national workshop, Brainstorming (STEEP: Social, Technological, Economic, Ecological, Political Issues), national panels, SWOT analysis, prioritisation, Delphi survey, scenarios, and the 'hard' methods - Performance indicators, and critical influence analysis (CIA). Methods, designed in combinations, comprised a unified project process, where real and virtual/online work co-existed in many cases.

Handbook of Knowledge Society Foresight

The most tangible result of the environmental scanning was HKSF produced in the first part of project. Findings of environmental scanning were used in many other methods undertaken in Euforia, for example for:

- Identifying new potential performance indicators;
- Preparing questions for the brainstorming exercises;
- Preparing a draft list of STEEP issues (e.g. brainstorming method);
- Informing national panels about major KS concerns;
- Providing draft categories for structuring the Delphi process;
- Identifying key aspects to be considered in scenario activities.

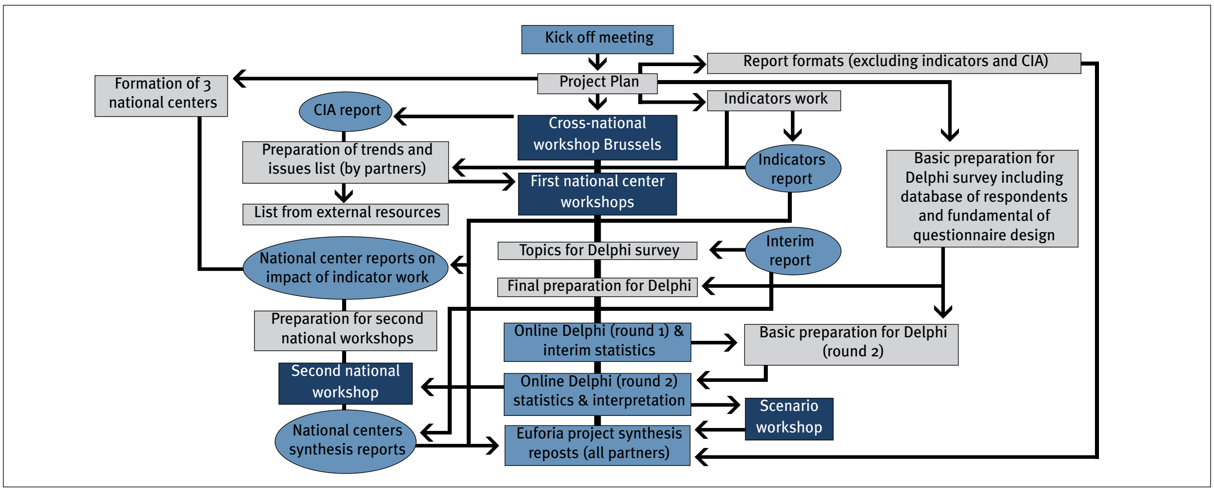
The chart indicates the direction of the flow of information across the methods combined in Euforia.

The cross-national workshop that took place within the framework of a conference "European Knowledge Society Foresight – the Missing Link between Technology Foresight and the Lisbon Objectives?" (21-22 November 2002, Brussels) provided perspectives for the Euforia national studies, and the synthesis that will follow them, concerning the processes involved in the development of European KS. The work on the HKSF was featured in the conference.

The Handbook tackles the major questions that have to be considered in embarking upon KSF (largely using a question-and-answer format) and sets out methods and approaches to draw a host of conclusions on the KS and its influence on concern areas of the Foundation. HKSF deals with conceptual issues, looks into matters of principle and objectives, provides methodological and practical application.
Annexes include resource materials and essays for stakeholders wishing to pursue the KS, knowledge management and foresight intelligence more deeply.

The Handbook suggests that a more useful way of thinking about the knowledge society should involve the intersection of several related trends. These are:

- the development of information societies based on the large-scale diffusion and utilisation of new information technologies (IT), which have allowed for unprecedented capabilities in capturing, processing, storing, and communicating data and information;
- the increasing importance of innovation (technological as well as organisational) as a source of competitiveness, and an instrument for increasing the efficiency and effectiveness of organisations of all types;
- the development of service economies, in which the bulk of economic activity, employment, and output is taking place in service sectors of the economy, and where specialised services are providing critical inputs to organisations in all sectors on a vastly increased scale;



- knowledge management arises as a specific issue, as organisations seek to apply formal techniques and new information systems to help them make more effective use of their data resources, information assets and expertise;
- other important developments related to the points above, including globalisation, changes in demographic structures and in cultural practices, and environmental affairs.

This is not a detailed map or model of a KS. 'Dealing with uncertainty', mutually reinforcing and evolving factors, that are foresighted and reflected in HKSF, have implications for both living and working conditions and industrial relations challenging the Lisbon agenda in Europe.

Social Innovation Needed for Improvement of Work and Life

The European KSF project resulted in wide-ongoing outcomes in 2003-2004. A set of reports was published in electronic format and disseminated during the Irish presidency EU conference 'Foresight for Innovation - thinking and debating the future: shaping and aligning policies' (14-15 June 2004, Dublin).
Euforia proved in practice a developmental type of project that encompassed integrative, explorative, experimental, and forward-looking features. The project discovers that KSF is a particular foresight area. It goes further than typical technology foresight, since it is designed to inform a wide range of policies relevant to social and organisational innovation, as well as technological innovation. In Europe, institutions and practices must rise to the challenges of social change in general (e.g. demographic change, globalisation, etc.) as well as to change associated with the production and use of new knowledge. The study indicated various points at which social innovation seems to be particularly problematic - for instance, the work-life balance emerged as a recurrent source of concern, there were problems seen in the adaptability of trade unions, the much-heralded network organisations were felt to be slow in developing, ethical considerations were not expected to take a prominent role in working life, and so on. Social innovations, and the social forces to develop, diffuse and implement them, are clearly called for.

Time Series of Indicators Show Trends of North-South Divide

The ways in which KS issues are mutually shaping, and being shaped by, policies and strategies of many kinds are in the making. Euforia studied problems of the appropriateness and quality of statistical resources and data for the measurement of KS developments. The advancement indicators report provided detailed data on a range of topics. Country profiles were produced for Finland, Germany and Greece, alongside with EU aggregates and overall comparisons of the EU countries. Where possible, the approach was to generate and present time series data on indicators, which would assist in the identification and elaboration of trends. The KS advancement indicators (for the European countries, the US and Japan) and the analysis report provided a key empirical basis on which the subsequent discussions in the workshops and the empirical part of the scenario development were based.

It can be said that the KS has arrived in the EU but not everywhere and not for everyone. A knowledge society north-south divide can still be observed in Europe. Looking at competition and innovation, the European Union, that brings to bear many advantages, has the potential to find its own way, which is likely to differ to that of the US and Japan.

Delphi Across Disciplines and Countries

The KS Delphi was the way chosen for eliciting expert opinion on the likely occurrence of specific topics. It required the preparation of a carefully designed sequence of interrogations, through web-designed questionnaire, interspersed with the recycling of earlier results. The Delphi looked at 12 cross-national social, technological, economic, environmental, political and values-related (STEEPV) trend statements, clustered into six categories: governance and mobility, health and privacy, industrial relations, living conditions; sustainable development, and working conditions. This exercise became a unique example of foresight practice where new forms of networking and technical skills were combined to produce cross-national and multi-lingual online instrument. Rich information was produced about respondents' perception on how developments towards a European KS would impact over the future of working conditions, industrial relations and living conditions at both the national and the EU contexts. Results of the Delphi were used as input for the discussions at the national scenario workshops as well as to prepare a full Delphi-based scenario.

Scenarios to Point to Different Futures

National workshops indicated different possibilities of the KS development in the pilot countries. They also illuminated new organisational forms that allow for new ways of generating and mobilising knowledge. The Euforia scenarios were developed from the application of various foresight methods providing outcome of a consistent and critical analysis of some of present and emerging drivers/trends in European societies (STEEPV framework). E.g. in Greece, based on the current situation and the major drivers and trends that characterise country's path towards the knowledge society, experts have developed three scenarios:

- The 'awakening' scenario, which is characterised by social change and radical reconsideration and where

conditions are created for the trends to have a positive impact and for the negative effects to be tackled.
- The 'lethargy' scenario, which shows no major changes from today. This was presented to verify once more the current trends and drivers and their interactions and impact rather than to develop a specific scenario.
- The 'nightmare' scenario, which shows negative effects resulting from ineffective measures, an absence of real change and other external factors that have serious consequences.

Scenarios show optional ways of how the future may look like in Finland, Germany and Greece. They aim to specify necessary policy implications, social innovations and roles of key players to achieve them. Scenarios could be useful for consensus development on vision of the KS future.

Euforia was not intended to be a comprehensive foresight study. The modest nature of the project lead the Euforia project team to caution against simplistic extension of the outcomes into fields and uses that the data and information reported do not support.

Policy Implications Reaching from the North to the Mediterranean

Both processes and results related to Knowledge Society Foresight Euforia have a number of implications for policy makers. The project indicates that coordinated policy actions will help shape the KS, and foresight provides an opportunity to reflect on just what sort of KS is in the making. This interrelation helps to overview the positive paths of development towards the KS and to avoid negative paths. The KSF contributed to EU Information Society policies and programmes dealing with the Lisbon and Sustainable Development strategies and issues.

Euforia managed to raise awareness and interest on KS concerns in various EU countries; inspired the European Foundation to produce a general model for national KS foresights and adopt foresight methodology as a part of its research strategy; motivated the Greek Technology Foresight Programme to create a new working group on Foresight and Society; influenced the 2004 discussions on the KS strategy of the Finnish Parliament; motivated KS research in New Member States, particularly in Malta; inspired further research at PhD level (e.g. in Greece, Germany); stimulated KS initiatives at the academic & public sectors in Latin America. Euforia's online Delphi structure and platform has been used by PhD researchers in the UK and governmental authorities in Latin America to design other studies. The Euforia developed methods have been applied in European foresight, e.g. FISTERA. In 2005, a report 'Ireland and the knowledge society' outlined the steps taken in Euforia that could be used to inform an Irish KS project. Options for further development of KSF were explored in an Irish context. The Euforia results are stimulating inputs for foresight and other Strategic Policy Intelligence processes, and projects (e.g. RegStrat) undertaken in this context to inform S+T+I policy decisions.

Practical implications of Euforia point to the 'localisation' of KSF. The Lisbon process discovered diverse forms of emerging KS within the EU. The KSF project provided considerable scope for learning not only about how to achieve objectives, but also about what objectives are worth pursuing (and perhaps this is the most fundamental sort of knowledge that a KS could be creating and acting upon). KSF work needs to be much more embedded in the country/region and organisations involved.

Sources and References

The results include: European knowledge society foresight: the Euforia project synthesis (report); Handbook of Knowledge Society Foresight; Advancement of the knowledge society: Comparing Europe, the US and Japan; The EUFORIA cross-national workshop; The EUFORIA Project Delphi Report; The Knowledge Society in Finland: Current situation and future trends (report); The Knowledge Society in Germany: Current situation and future trends (report); The Knowledge Society in Greece: Current situation and future trends (report); Xtreme EUFORIA: Combining Foresight Methods.

The Millennium Project 2050

Authors:	Kerstin Cuhls / Kerstin.Cuhls@isi.fraunhofer.de		
Sponsors:	The UNO, UNDP, and UNESCO The U.S. Environmental Protection Agency Many other organisations including companies like Motorola Corporation, Shell International, Monsanto Company and Ford Motor Company. For a more exhaustive list go to www.acunu.org/millennium/affil.html		
Type:	Multinational continuous Foresight exercise		
Organizer:	It was initiated and coordinated by the American Council for the United Nations University in cooperation with the Smithsonian Institution, The Futures Group, and the United Nations University at Jerome Glenn. For a complete list see www.acunu.org.		
Duration:	Continuously since 1996	Budget: € 230 000 per year excluding special studies	Time Horizon: Various time horizons up until 2050

Purpose

The Millennium Project assists in organizing futures research, improves thinking about the future and makes that thinking available through a variety of media for consideration in policy-maker, advanced training and for feedback. The goal is to accumulate wisdom about possible futures. The project is designed to provide an independent, global capacity that is inter-disciplinary, inter-institutional and multi-cultural for early alert and analysis of long-range issues, opportunities, challenges and strategies.

Fostering Thinking about the Future

The Millennium Project provides an intellectually, geographically, and institutionally dispersed think-tank capability. It is designed to provide an independent, global capability for interdisciplinary, inter-institutional, and multi-cultural for early alert and analysis of long-range issues, opportunities, challenges, and strategies. The insights and information generated are made available through a variety of media for consideration in policy-making, advanced training, public education, and feedback is welcomed. To achieve this, the project has established an international network of experts in futures research to gain access to global knowledge on futures issues. The source of sponsorship varies. Institutes and private companies are regular sponsors. Sponsorship is sometimes linked to the commissioning of special studies.

The Mix of Methodologies Applied

The main tool of the Millennium Project is its network of experts that provide quick and easy access to international knowledge. Regular Delphi surveys are carried out to gain information about global challenges and to provide assessments of these challenges. The SOFI Index (State Of the Future) enables one to make historical comparisons of the results of this work. Global scenarios are developed concerning specific challenges that may be normative, exploratory or long-range in nature. Scenarios on issues such as the development of science and technology, counter-terrorism or peace in the Middle East are written in an open way without the use of formal scenario workshops. Reports mix quantitative and qualitative approaches in a very open and flexible way.

The Network of Futurist Experts

The network relies on 25 so called 'nodes' based in Argentina, Australasia, Brazil, Belgium, Canada, Central Europe, China, Egypt, France, Finland, Germany, the Gulf Region, Iran, India, Italy, Japan, Mexico, Russia, Silicon Valley, South Africa, South Korea, the UK and Venezuela as well as an Experimental 'Cyber-Node' based in Hawaii. These nodes are involved in planning the project and in the different surveys it performs. The involvement of such nodes allows the project to connect global and local perspectives. The nodes identify knowledgeable and creative people in their region, translate questionnaires, conduct interviews, and disseminate project findings.

'The 2005 State of the Future'

Futures Research systematically explores, creates, and tests possible and desirable futures to improve decisions. Decision-making increasingly factors in effects of globalisation. The issues and the solutions of our time are increasingly trans-national, trans-institutional and trans-disciplinary.

It is increasingly participative. 'The 2005 State of the Future' provides an additional view on global change.

The annual 'State of the Future' survey provides a global strategic landscape that public and private policy-makers may use to improve their strategic decision-making and global understanding. Anyone is allowed to make use of the results. Business executives can use the research as input to their scenario planning, university professors, futurists, and other consultants may find the information useful in teaching and research. Nine 'State of the Future' surveys have been conducted until now. So far 1,983 experts have been involved in this work. The latest survey alone, conducted in 2005 involved 454.

Ethical issues and how they will develop have emerged as increasingly important for the future. Examples of key questions arising in this context include: What ethical behaviour should guide corporate and economic decisions? What ethical issues are involved in attempting to improve global education? What new ethical challenges stem from biotechnology and public health? Media publication policies raise ethical questions about censorship. What are the new questions of religion and moral philosophy? Is it right for people of wealth to have advantages? What is a future-crime? From these questions, ethical principles and value statements were derived and the time horizon for their realisation assessed.

The project's global scenarios included simulations, drivers of global developments and even very long-term developments.

The **counter-terrorism scenarios for example** include descriptive scenarios such as **'Escalation'**, **'Counter Mindset'** with a mind of restoring the right and proper image of Islam, **'Root Causes'** with a failure to end terrorism with military means but after a short period of expansion, terrorism loses ground, **'Socratic Justice'** with the help of the UN, **'The Wild West'** where terror meets terror and **'The Peaceful Cowboy'** scenario in which cooperation with other nations improve internal security, enhance intelligence and enables economic activity. Other scenarios include **'The Next Year'** concerning an invasion of the Taliban areas, **'Fortress USA/OECD'** with closed borders, **'Establishing a Global Civic Ethic'**, **'Colonialism Reborn'** and **'Call on the UN'.**

The Science and Technology 2025 Global Scenarios are:

- **S&T Develops a Mind of Its Own**: Collective human-machine intelligence has dramatically increased. Customized neural nutritional supplements, genetic medicine, universal cognitive development access, and TEF (Tele-Everywhere-Feedback protocol) with CyberNow clothing and glasses achieved miracles in human performance, social stability and economic growth. The forces behind Moore's law have not only accelerated computer capacity but also all phenomena connected to computing …
- **The World Wakes Up:** The murder of 25 million people over a three-month period in 2021 in major population areas around the world by a self-proclaimed **AOG** or Agent of God finally wake up the world to the realization that an individual acting alone could create and use a weapon of mass destruction. In this case Congo virus genetically modified using available simulation software and a genetic engineering kit stolen from a university. The phenomenon was called **SIMAD** for Single Individual Massively Destructive …
- **Please turn off the Spigot** concerns the Man of the Year in 2025, an anti-science hero who is in fact pro 'responsible' science and regards science and religion as parallel. He writes about how scientific results are used, positively or as weapons on 'black markets' and where concern for the work of one lab is addressed by another laboratory taking it up whenever funding is available …
- **Backlash** is about moral issues and the evaluation of science. Arguments for the international control and regulation of science as well as for the self-regulation of science are given. Nevertheless risks deriving from science cannot be omitted. Under the Principles of Inviolability of Science with a kind of certificate, science blossoms, many new discoveries were made. Problems arise however and the Jakarta 2 resolution to establish a global science commission is signed with negative effects. Nobody works on 'risky' science anymore, horizons shrink, goals are diminished, the global economy winds down, poverty rises, and the safety zone of reduced risk that global regulation was supposed to provide proves not to be so safe after all …

Three normative **Middle East Scenarios** round off the picture of the global scenarios. These are:

- **Water Works:** The need to increase water supply encourages political negotiations and helps to build trust in the possibility of peace. UN troops enforce agreements and new forms of international collaboration cement the peace …
- **The Open City**: A new Pope challenges Jewish and Muslim religious leaders to solve the question of governance in Jerusalem. Politics, power, and media all play a role in supporting a proposal for a solution that is ultimately adopted as a resolution of the UN General Assembly …
- **Dove:** This is the name of a secret contested Israeli plan to de-escalate and unilaterally renounce retaliation to demonstrate that Palestinians were aggressors … a separate debate is going on among extremist Palestinians. At the same time 27 Israeli pilots refuse to participate in future air raids. As in a chess game, de-escalation becomes possible and a series of non-aggression treaties and agreements are signed stating that Israel has a right to exist …

In the 'State of the Future' and other works of the Millennium Project 15 major issues for the future are identified. These **15 global challenges** may come as no surprise:

1. How can sustainable development be achieved for all?
2. How can everyone have sufficient clean water without conflict?
3. How can population growth and resource consumption be brought into balance?
4. How can genuine democracy emerge from authoritarian regimes?
5. How can policy-making become more aware of global long-term perspectives?
6. How can the global convergence of ICT work for everyone?
7. How can ethical market economies be encouraged to help reduce the gap between rich and poor?
8. How can the threat of new and re-emerging diseases and immune micro-organisms be reduced?
9. How can the capacity to decide be improved as the nature of work and institutions change?
10. How can shared values and new security strategies reduce ethnic conflicts, terrorism and the use of weapons of destruction?
11. How can the changing status of women help improve the human condition?
12. How can transnational organized crime networks be stopped from becoming more powerful and sophisticated global enterprise?
13. How can growing energy demand be met safely and efficiently?
14. How can scientific and technological breakthroughs be accelerated to improve the human condition?
15. How can ethical considerations become more routinely incorporated into global decisions?

Activities Derived from the Millennium Project

General Users

Companies sponsor studies by the Millennium Project only if they expect to obtain useful results such as insights that apply to their own context that they can use in their own strategic decision-making processes. Project findings are applied by the Millennium Nodes in their own ongoing work. Sections of 'State of the Future' reports have been used as university and high school texts.

Statements of the millennium project about global challenges do not represent consensus views. They are a distillation of a range of views from diverse participants. Data are not representative in the sense that they based on small survey samples. The diversity of opinions solicited means that issues raised and recommendations given may sometimes seem contradictory. Some may even sound like political clichés. Nevertheless this kind of 'information about things to come' is regarded as important by different decision-makers.

Influence of the Millennium Development Goals as a Focus for Action

The UN Millennium Project 2005 led to the formulation of eight global millennium goals with targets indicating how these goals could be made measurable and operational. These were recommended for the UN in a report in 2005. They are as follows:

GOAL 1: Eradicate Extreme Hunger and Poverty
Target 1: Between 1990 and 2015 halve the proportion of people whose income is less than $1 a day
Target 2: Between 1990 and 2015 halve the proportion of people who suffer from hunger.

GOAL 2: Achieve Universal Primary Education
Target 3: Ensure that by 2015 children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.

GOAL 3: Promote Gender Equality and Empower Women
Target 4: Eliminate gender disparity in primary and secondary education, preferably by 2005 and in all levels of education no later than 2015.

GOAL 4: Reduce Child Mortality
Target 5: Between 1990 and 2015 reduce by two-thirds the mortality rate for under-fives.

The Impact of the Millennium Project

Critics of the Millennium Project claim it is superfluous because the problems and issues it raises are well-known. The results of the Millennium project in terms of 'questions raised' are clear, but answers to these questions would change the world. So is the Millennium project merely an idealistic endeavour?

Recommendations of the project comprise plans to achieve the Millennium Goals as well as guidelines for governance. The contribution of civil society is also discussed. Indicators for improvement are provided and achievements are evaluated.

The specific needs of regions such as Africa or of countries in conflicts are also stressed. Special emphasis is placed on recommendations for an international system to support country-level processes. Trade is an important point of discussion. Even the costs and benefits of achieving millennium goals are investigated and described. What remains unclear is whether progress on such issues arises as a result of the recommendations, as a result of other recommendations or as a result of progress towards general United Nations objectives.

It is true that many of the issues raised are well known. However if they are not gathered, written down and assessed, no one will listen. Without giving recommendations to the United Nations, how would they know? Who else would be interested in changing the world and improving the conditions for poor-people-without-a-lobby, if not the United Nations? So the recommendations in annual and special reports make sense. They serve as a reminder of the problems that are still unsolved.

Results of the millennium project are used to prepare general high ranking events such as summits. These lead to tangible outputs such as the United Nations Millennium Declaration, Resolution adopted by the General Assembly in its 8th plenary meeting on 8 September 2000, which is cited in Annex G-4 of the '2005 State of the Future' report, or in publications by the United Nations such as the year 2000 'We the Peoples' address by Kofi Annan. In all these cases however it is difficult to trace back what the source of the single information is. This is a problem that often exists in foresight.

It is also stated that the 15 Global Challenges are regarded as a framework for thinking about the world as a whole, to mitigate risks and seize opportunities. The SOFI or State of the future Index allows one to track different expectations and opinions over time. All in all, the project steers the attention of policy makers to the broad challenges of the world.

Because of its world-wide-network, the usage of information is not limited. The Chinese editions are even acknowledged by Chinese policy makers. Some of the water recommendations were incorporated into Chinas **11th Five Year Plan** and its **Long Term Plan for Social and Economic Development** includes water-saving technological innovations, ecological engineering for water conservation and sewage treatment, eco-system based watershed management and eco-service zoning for nature conservation. Population recommendations and recommendations about energy were also taken into account. Nevertheless it is difficult to trace what had the direct impact.

'Yes' the Millennium Project is an idealistic endeavour. The project is also run on a very low cost basis. It exploits opportunities to commit people and even companies to its goals. It informs the UNO, its nodes, different governments, companies, research organisations and others. The information it provides is not always surprising, not always really new, but it is an important part of the puzzle of what the world will look like in the future.

Sources and References

A major output of the Millennium Project is the annual report about 'The State of the Future'. The 2005 report includes a CD ROM containing collected works of the project, details of the 'State of the Future', scenarios, indicators as well as an explanation of the main methods applied in Futures Research.

- Annan, Kofi (2000): 'We the peoples ...' United Nations Department of Public Information, New York, **www.un.org**
- State of the Future 2005, **http://www.acunu.org/millennium/sof2005.html**
- State of the Future 2004, **http://www.acunu.org/millennium/sof2004.html and previous versions**
- UN Millennium Project (2005): Investing in Development. A Practical Plan to Achieve the Millennium Development Goals, **www.unmillenniumproject.org.**
- Publications are available at **www.millennium-project.org**
- For teaching and methodological purposes a CD ROM 'Futures Research Methodology – V.2.0' is available via the website **www.unmillenniumproject.org.**

Austrian Tourism 2015

Authors:	René Mittringer, ARC Systems Research / Rene.Mittringer@arcs.ac.at		
Sponsors:	The Austrian National Tourist Office		
Type:	National foresight exercise on tourism		
Organizer:	Austrian Tourist Agency		
Duration:	1997-2005	Budget: N.A.	Time Horizon: 2015

In 2004 tourism in Austria contributed 6.4 % of the nations GDP equivalent to € 15.26B. This number however fails to capture the complexity of this economic sector. Just as for any sector a strategic plan is needed to focus efforts on the needs, risks and opportunities for the future. For these reasons the Austrian Tourist Agency initiated a series of scenario workshops and processes to explore plausible future developments.

Tourism meets DaimlerChrysler

It is not easy to measure the value of tourism for a country in economic terms although several approaches are designed for that. However it is quite easy to tell that tourism is of high importance for a country like Austria and this implies the need of forward looking approach.

A series of scenario workshops were carried out by the *Austrian Tourist Agency* to develop consistent visions for the future. Initially these were based on themes such as winter and summer tourism, city and health tourism.

The scenario processes were structured in the same way for each of these market segments and comprised the following sequence of steps:
- Analysis of current developments in the segment,
- Analysis of the environment,
- Formulation of scenarios to manifest possible future developments,
- Definition of conclusions with recommendations for future activities.

Designing business areas or product policies for the long run are coherently connected with uncertainty about the development of surrounding key factors and individual decisions in a dynamic environment. A systematic and complex analysis was needed to frame the relevant issues and their dependant variables as close to reality as possible. The scenario technique used was organized with the help of experts from a variety of organisations including *DaimlerChrysler and CAP Gemini Ernst & Young.* In so called 'future laboratories' scenarios were gathered as a result of structured communication between experts with various professional and personal backgrounds. An essential element of this exercise was the 'team building' to develop a comprehensive view on the segment in question and to ensure an appropriate level of reflection on the matter.

The Four Seasons

The tourism authority made a preliminary choice of the following four core segments:
- Winter tourism.
- Summer tourism.
- City tourism.
- Health tourism.

The Future of Winter Tourism

The main travel season in Europe is the summer time. Not even one third of those who travel abroad each year, do so in the winter. Of those only 12% go for a vacation in the snow because most still prefer the so called 'Sun & Beach' holiday. Nevertheless Austria remains one of the most popular winter holiday destinations in Europe. According to a survey of the tourism consulting group - IPK International, 47% of the Europeans chose Austria followed by France with 14% and then by Italy and Switzerland with 11% each.

Four scenarios were developed for the future of winter tourism in Austria. These can be summarised as follows:
- **Heaven & Hell:** This scenario is based on the anticipated future income gap. There will be a first class tourism segment on the one hand with all-inclusive low price packages on the other. Individually oriented high-quality service models will become increasingly standardised on the basis of global franchise systems.
- **Good Bye Snow!** As a result of climate change only a few winter sport islands remain. These are affordable only by high end clients. Alternatives are in short supply.

The need for a 'snow experience' slowly fades in people's minds. Instead artificial snow in huge ski domes with typical Austrian features provides the only substitute.

- **Ecological Winter Breaks**: A shortage of natural resources, traffic overload and environmental pollution bring about structural changes and lead to an increase in so called eco-taxes. People are more sensitive about natural resource usage and the impact of activities on the environment. High fuel prices lead to a preference for holidays in the neighbour countries rather than in far away places. Austria's geographically central position and its advanced position in ecologically sound tourism is well matched to existing demand.
- **Ski, Snow & More:** Skiing is still a trendy past time and ski breaks can be booked online through the television. Clients like to mix skiing with extra features such as show and concert events preferably using all-access cards. New sports activities can be tested in safe surroundings using recently developed tools such as the 'Virtual Try Simulator'.

The Summer Challenge

The most favourite kind of holiday for the Europeans is Sun & Beach, 41% of holiday makers prefer this, 18% prefer organised tours and 14% go for the city breaks, whereas vacations in the country side or in the mountains account for about 6% of all holiday travel. From 1980 to 2000 arrivals in Austria increased by 15% but this was accompanied by a decrease in overnight stays. Germany and Austria account for 76% of these overnight stays. Visits by Germans and Dutch have decreased whereas the proportion of Swiss, Italians, Japanese and Austrians staying overnight has been on the rise. Based on these premises the following four descriptors were employed in a series of future workshops as criterion for the development of summer tourism scenarios:

- Basic requirements
- Highly competitive surrounding
- Socio-economic trends
- Start of the WWW-Tourism era

- **The Real Austria – Demand for Real Nature:** As EU and national subsidies for the agriculture are no longer available anymore, the regions of Europe have picked out tourism as an important source of local income. The development of such a market is supported by a strong demand for authenticity or experience and for natural products. 'Nature' however is in relatively short supply and people are willing to pay a high price for last surrender-spots of authentic nature in 'Good Old Europe'.
- **Mountain Experience:** People spend more time traveling during their holidays than ever before and sporting activities are still a key source of income. Innovative new sport products like the Cotton-ski™ for downhill skiing open the summer tourism for established winter-sports enthusiasts. These products are based on an easy-to-learn philosophy appropriate for any age-group.
- **Lonely Mountain:** The demand for entertainment and for variation drive tourists to destinations in the south rather than to classic, mountain vacations. Insufficient bad-weather alternatives and a lack of tourism product innovation led to continuing decrease in summer tourism.
- **Sea or Lake:** Aggressive ultra-violet radiation increases in southern countries and environmental awareness is generally greater than before, but nobody wants to miss out on the water experience. The high water-quality of Austrian lakes and the broad spectrum of recreational and adventure facilities boost summer tourism.
- **Stock up on Life:** A complete and convenient group of services makes Austria a leading wellness resort destination. Highly qualified employees are trained to provide for the needs of the individual and help them enjoy a perfect Body & Soul experience.

The Hot Spot City

The age of a typical city tourist is below the average of the population and for four out of ten tourists, a city trip is the main vacation of the year. The decision for the trip is made quickly and at short notice. The demand for information in advance of the trip is high. The daily spend of the city tourist is by a third than that of the average tourist and they tend to roam in couples.

The positive first impressions for a tourist in Austria are the cityscape, the friendliness of the people and the sense of safety of the place. Arrivals of city tourists by nationality in Austria's major cities are as follows:

Austria	28%
Germany	19%
Italy	9%
The USA	6%
The UK	4%
Japan, Spain, Switzerland and Liechtenstein	3%
France	2%

These five scenarios for the future of city tourism are as follows:

- **Telling (Hi)stories:** History is central to the tourism experience. Districts tell their own authentic stories of the people, inviting visitors to join in this unique experience.
- **Aqua City:** Intended as a case scenario for Graz this scenario looks at how the city grows in synergy with the water environment. Thanks to the use of high technology this becomes a unique selling point for the city.

- **Erlebnisstä(d)te®:** Roughly translated this trade-marked name refers to an 'entertainment city'. The creation of a city trademark ensures quality, excitement and emotion for city-tourists all over the world. Educational entertainment and special features are included and the expectations of every tourist to these trademark cities will be met.
- **Flex Living:** The city as a virtual reality show, where everything happens just in time. Technology supports and enables the new fast-and-flexible life style of the future city tourist-with-no-time.
- **City Escape:** Terrorism, environmental catastrophes and major traffic jams make cities generally unattractive. Only a few luxury segment tourists survive.

The Health Issue

People are developing a high level of consciousness for health and living while competition obliges the tourism industry to specialize and focus on new target groups. Austria must build upon and maintain its natural assets, its high water quality, its healthy bio-food and a good supply of comprehensive, integrated health-related tourism products.

People differentiate between holidays for wellness, health, fitness and recovery. At 4% of all holidays 'convalescence' represent the most important segment, but holidaying for fitness and wellness shows a strong positive trend.

Austrians themselves dominate this market followed by Germans, French and Swiss.

A New Vision of Living

The main goal for people in the new millennium is to prevent illness and to avoid the need for recovery. It is not enough anymore to reach a significant age. Fitness of the mind and overall well-being in terms of the overall quality of ones health is a crucial personal goal.

No matter what form of holiday is chosen, one of the most the determining reasons for the choice is the duration of the holiday.

What Does this Mean for the Future?

The implications of these scenarios for the future of tourism in Austria are listed on a 'last in – first out' basis.

The most important issue for the development of the health related segment is to build upon available competence in existing therapies and to ensure the highest quality of service.

At the same time, services provided must follow a holistic approach. This may mean considering 'new wave' treatments. The tourist experience will be based around facilities such as well-being oases, competence centers or hotels as well as multi-option health resorts.

In the 'City Escape' scenario for city tourism, societies' share of responsibility has to be supported. Donations to social and cultural NGOs will need to be made tax deductible. The city must set incentives for worthwhile international events. It needs to engage in sustainable traffic and environmental planning with a view to supporting the tourism experience. Policy should the needs of the middle class and the implementation of so called 'meet the citizen' programs. The 'Flex Living' scenario requires a focus on new state-of-the-art living, the establishment of digital information systems, the development of necessary hardware, the availability of individualized hotels and above all 24 hour service in retail and gastronomy. The 'Experience City' needs to come to a fundamental understanding of the experience it will offer. It needs to define its trademark, quality criteria and standards. It needs to promote these using an appropriate marketing strategy. In the case of 'Aqua City' urban wellness concepts need to be further developed and infrastructure needs to be upgraded. New business concepts for tourism and water need to be developed and resources are required to building consciousness of natural resources and the environment. The first scenario '(Hi)story Telling' requires an evaluation of what is authentic. The availability of information and tourist-oriented sights must be outlined. Tourist 'competence' is a key issue. Handcrafts and trade have to be recreated in a historic setting while addressing the new needs of the time.

Core elements of summer tourism in the 'Stock up on Life' scenario are the establishment of a comprehensive, high quality program for body & soul fitness as well as the development of highly qualified personnel. The option for individual attention from coaches and guides as well as continuous service chains will be indispensable. Regarding the 'Sea or Lake?' scenario, key issues that arise are the need for investment in summer attractions, the diversification of offers, the availability of animation and price optimization for day tourism. Beside the creation of new niche products price optimization will be very important for the 'Peaceful Mountain' scenario. The 'Mountain–Adventure' outcome will need new infrastructure on the mountain and the deployment of modern technologies in the right place especially to support sales related communication. Youth-friendliness needs to be improved along with 24 hour entertainment and services. In the case of 'Real Austria – Demand for Real Nature' Austria's authentic creditability must be established or increased and new appropriate product chains created. Natural assets such as water quality need to be promoted as unique selling points. Attention must be given to communicating these assets and to developing more educational forms of entertainment relating to nature, the body and personal well being.

In the winter holiday sector basic requirements were defined to meet the expectations brought about by heavy competition. These have to be implemented independently of which of the five development scenarios unfold. Because of worldwide competition, especially from Sun & Beach travel options, destinations have to be clearly positioned and prepared.

Good marketing networks will play a fundamental role. Potential lies in capturing the youngest and in supplying new products suitable for people in all age groups. Local and regional service cards combined with continuous service chains and a variety of events with regional identity can match tourists' need for flexibility. All this requires a sustainable ecologically protected environment, providing safety and public access to the product itself via all existing and new forms of media.

Responding to New Social Drivers

Whether or not the future unfolds according to one of these scenarios, socio-economic change is taking place that will have a profound impact on the future needs of the tourist.

Essential social drivers such individualization, flexibility and the aging of society will fundamentally change social relations. Patchwork-families, single households, serial partnerships and jobs will replace traditional structures and change how people holiday, with whom and when. So-called flex-jobs and project orientated engagements will replace traditional full time jobs. The average age of retirement will be 70 and an increasingly skilled labour force will welcome a higher proportion of working women. All of this will affects the 'new customer' in the ageing Europe of 2015.

One out of four customers will be above 60 and seniors will be among the most affluent clients.

The middle class will slowly disappear and in the hyper flexible, digital, networked economy, hybrid products will be designed. Discount will meet the premium class and the gap between those with 'lots of time and little money' and the ones with 'no time and lots of money' will get bigger.

Products and services will melt together. Product diversity will be crucial and the performance of the tourism industry in Austria will increase with societies' level of internationalization. The attention of future customers will count and destination marketing in the future will be based on competition between lifestyle labels or rather symbols.

Sources and References

http://www.austriatourism.com
http://www.austriatourism.com/xxl/_site/int-de/_area/465219/_subArea/465253/trends.html

European Manufacturing Visions ManVis 2020

Authors:	Heidi Armbruster / heidi.armbruster@isi.fraunhofer.de Carsten Dreher / carsten.dreher@uni-flensburg.de Petra Jung-Erceg / petra.jung-erceg@isi.fraunhofer.de		
Sponsors:	Directorate General Research, European Commission		
Type:	International foresight exercise		
Organizer:	Fraunhofer ISI - Institute for Systems and Innovation Research, Karlsruhe, Germany		
Duration:	2003-2006	Budget: N.A.	Time Horizon: 2020 +

Background

Europe has set itself the goal of becoming the most competitive economy in the world by the year 2010. Manufacturing is one of its strongest economic sectors. It provides a total of 27 million jobs and creates more than €1,300B in added value each year. In order to develop strategies for maintaining and improving the competitive strength of manufacturing industries in Europe, both industry and politics need convincing visions of the future of manufacturing in Europe. This is the background for the ManVis or 'Manufacturing Visions' project. The goal was to develop innovative and creative visions of European manufacturing for the coming decades.

Powerful Visions of the Future of Manufacturing

The ManVis project is an SSA or Specific Support Action financed by the European Commission. It was designed to accompany an ongoing process of developing policies to enhance the competitiveness of European manufacturing industries using a Foresight approach that includes the views of a wide range of European manufacturing experts. It was launched in 2003 in response to the following factors:

- Results from previous foresight activities and from empirical surveys indicated that manufacturing in Europe needed to strengthen its innovation capacity and to adopt a more proactive stance in the face of an increasing pace of product innovation.
- A trend towards and an increasing debate on the relocation of manufacturing outside Europe.
- Commission activities in support of manufacturing including MATAP – the Manufacturing Action Plan.
- The Need to define research priorities for the NMP action line of FP7 dealing with Nano-technologies, Materials and Production.

Industry, government, and other stakeholders need a strong vision on the future of the European economy based on an assessment of possible alternatives in order to develop their strategies. Such strong visions however do not appear spontaneously, nor can they be simply 'declared' by state authorities. They are not based on single perspectives or over specialised approaches. For these reasons a new knowledge community was created, concerned with the future of manufacturing, including as many actors and stakeholders as possible from Europe and all over the world.

Pan-European Delphi

As a tool to initiate future-oriented thinking and stimulate the involvement of people with diverse perspectives, the ManVis project launched a pan-European Delphi survey on manufacturing issues. The advantage of this approach is its ability to collect a large amount of information in structured form.

Manufacturing experts from Europe and overseas contributed to the shaping of the survey through a series of workshops. In order to avoid an isolated view of European manufacturing issues, experts from outside Europe were involved in the development of the statements of the Delphi questionnaire and commented on the results of the survey. An important aim of this project was to emphasise and elaborate demand side perspectives on manufacturing. For this reason consumers and other societal groups concerned with the future of manufacturing were involved in discussions on the findings of the Delphi survey. In parallel to the Delphi activities, scenarios were elaborated on the development of the demand side of manufacturing.

The ManVis Delphi survey was launched in 22 European countries - Austria, Belgium, Bulgaria, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, Turkey and the United Kingdom. A core team of researchers from eight European institutes, each focusing on particular aspects of manufacturing, were selected to provide a holistic view on the subject. This group designed and conducted the Delphi survey. National partners from each of the 22 European countries provided support for the Delphi process in their own country. The survey was shaped by discussions in 22 national workshops involving 280 manufacturing experts from Europe and beyond with backgrounds in research, industry and public policy.

From Technologies to Working Conditions

Previous national and international studies on manufacturing industries focused on individual aspects of the manufacturing sector such as technology development or materials research. In contract to this ManVis set out to develop more holistic visions of the future of production. The declared objective was to examine the widest possible spectrum of interests, not simply those of researchers but the interests of other stakeholders as well. As a result the Delphi survey covered developments in all relevant aspects of manufacturing:

- Manufacturing technologies,
- Strategy,
- Organisation and management,
- Product features and concepts,
- Logistics and supply chain management, as well as
- Working conditions.

Enabling technologies for developments in all of these areas were examined. New demands for skills and competencies were deduced from the results and sustainability issues were a special focus throughout the project. Some statements in the Delphi questionnaire dealt with sector specific developments such as transport, machinery and traditional products.

Over 3,000 Experts Surveyed

The subsequent Delphi survey was conducted via an electronic questionnaire which was mailed to manufacturing experts – representatives from industry, research and policy in the 22 European countries listed above. Over 3,000 experts participated in the first round of the survey. The questionnaire was shortened for the second. Conflicting statements were regrouped and their first round results were presented jointly for re-consideration. A final project conference was held on October 24 and 25, 2005 in Bled, Slovenia. Entitled 'European Manufacturing – Quo Vadis?' the goal was to present the results of the Delphi and discuss its interpretation. The primary objective being to reflect on the development trends and visions that had been formulated, with help from manufacturing experts of different national and professional backgrounds. Discussions covered results and visions for the future of manufacturing as well as paths to secure the long-term competitiveness of the sector in Europe. A total of approximately 180 representatives from industry and academia as well as from European and national political institutions involved in the manufacturing industry participated in the conference.

Manufacturing Trajectories

Several possible trajectories for developments of the manufacturing of tomorrow came out of the ManVis findings:

- The struggle on labour cost competition will prevail in the years to come. Basically there are two dimensions to this. The loss of manufacturing operations to countries outside the European Union and movement within the European Union. The strategies that emerged from the ManVis expert consultation were mainly reactive. In other words they were based on cost reduction through automation and enhanced labour productivity. For the time being the New Member States will exploit a labour cost advantage. However they will lose this faster than competitors outside Europe. Without their own capacity for innovation and for the absorption and enhancement of new technologies and practices, such foreign direct investment will pass through these Member States in as little as a decade. Both inside and outside Europe labour-cost competition will lead to a loss of employment in manufacturing.
- Recourse to local manufacturing operations and the promotion of excellence in local R+D reflected a generally reactive attitude to change. Often based on concepts originating from the 'sustainable development' debate this vision is characterized by local manufacturing operations and very close interaction with local users who still have purchasing power. The consulted manufacturing experts were quite sceptical on the prospects of this option because of their assessments on the weak ties of modern manufacturing to its environment. Other stakeholders however considered this concept as being both feasible and competitive.
- In the view of both experts and other stakeholders eco-sustainable manufacturing based on new products, new materials and energy efficiency as well as on advanced product service systems could be developed into a competitive advantage for Europe. Regulations that create demand pull as outlined in the FutMan policy scenarios for example could have a positive impact because of the excellent EU R+D position in this field.

- High end manufacturing will be based on the efficient use of sophisticated manufacturing technologies that will enable world class highly automated operations for new products. This lofty ambition will require exploitation of the EU capabilities in micro electro-mechanical systems and related nano-technologies. It will mean addressing gaps in automation and research on manufacturing with new materials. Nevertheless this high efficiency approach will only reduce or maintain existing employment levels in European manufacturing.
- The most ambitious and far-reaching vision to emerge is that of European best practice in competing on the basis of the complete firm level innovation system. This view integrates user interaction with product design, development, production, supply chain, and logistics. The successful mastering of such 'systems' is considered the most promising way to ensure long-term competitiveness of the sector. Innovative and adaptive lead markets however must give European companies the chance to be the first to learn how to develop effective mechanisms for user-customer interaction to exploit this advantage.
- Nonetheless high-end manufacturing with sophisticated technologies is a pre-requisite for any employment creating option.

Safeguarding Jobs in the Manufacturing Sector

In order to move along these paths, create employment in EU manufacturing sectors a number of severe challenges must be addressed:

- Create manufacturing sectors that rely on sophisticated technology,
- Develop knowledge based, learning companies and industries,
- Compete on the basis of firm level innovation systems,
- Redefine demand and innovate through lead markets,
- Keep Europe economically united.

Because the science base in manufacturing is of growing importance, relevant topics and issues should be included in the funding mechanism of the planned European Science Council. Other existing mechanisms on the transfer and mobility of researchers have to be maintained and support provide for international cooperation.

In the view of the experts consulted, high-end manufacturing will not create new employment it will safeguard existing jobs and existing levels of employment. It is a necessary condition for the more advanced, employment creating trajectories. A successful strategy with high economic impact based on eco-sustainability will requires not only high technology but the professional organisation of new product-service concepts.

More Research

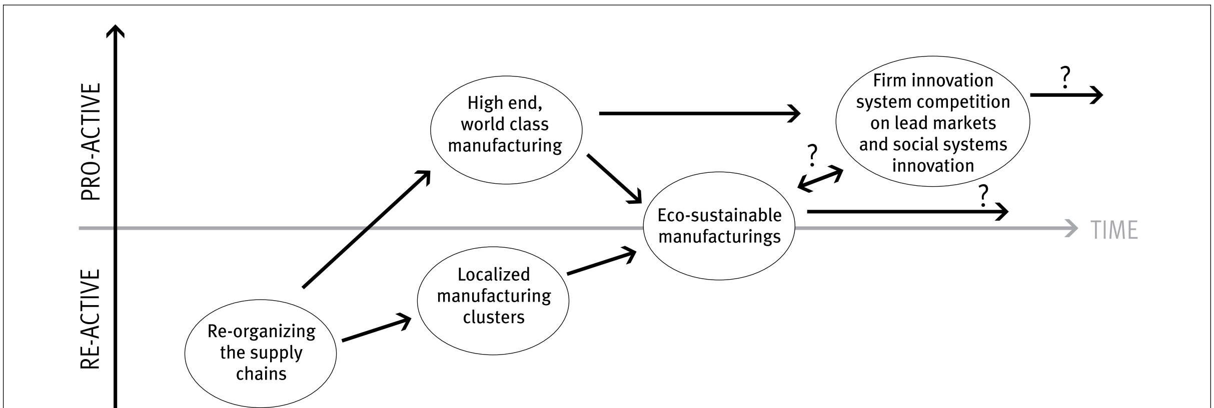
Excellent research projects are needed to address the following challenges:

Paving the way for new technologies in manufacturing

- Roadmapping and foresight on manufacturing relevant nano- and (white) bio-technologies,
- Measurement and workplace safety for nano-technology and bio-technology,
- Applied basic research for white bio-technology and nano-manufacturing.

Industrialising technologies

- Processing and manipulation of new materials,
- Incorporating smart materials into components for process technologies,
- Combining new materials incorporating micro electrical mechanical or adaptronic systems,
- Exploring new knowledge for modelling and high power computing for the simulation of product development, material behaviour and virtual experiments.



Trajectories for Manufacturing Paradigms of Tomorrow

Exploiting technology advantages

- Micro-systems in machine tools and products,
- Intelligent mechatronic systems for automation and robotics used for example in self adapting components,
- New automation technologies using advanced man-machine interaction that accounts for diverse worker capabilities,
- New ICT-tools for traditional manufacturing sectors.

Technologies for customising products/services

- Tagging and labelling technologies
- Approaches to product customisation using software or electronic components that allow for maximum flexibility and user integration
- Technologies and concepts that facilitate user integration into innovation processes
- Technologies and concepts that facilitate personalisation and build to order concepts
- SME appropriate tools for networks and logistics

Enterprise Innovation Systems

It is important not to concentrate on technological developments alone but to consider the whole system of innovation in firms. This implies tools, strategies, methods and procedures for product development, logistics, innovation management and business concept development must be added to the technological research agenda. The main challenge towards more pro-active strategies lies in the implementation of successful learning companies which can quickly adapt their innovation system.

Enhanced funding mechanisms should focus on the integration of user-interaction mechanisms. Accompanying measures should ensure the transfer of R+D results by feeding them into other relevant policy processes such as standardisation and regulation as well as ensuring widespread dissemination.

A harmonized policy approach is absolutely necessary if the requirements or society and existing competences are to converge into a series of lead markets. First mover advantages can only be obtained if quick and decisive moves in the creation of demand and in the shaping and building of new competencies are made. In order to be successful a thorough analysis of long-term demand and the interactive participation of stakeholders and users will be decisive for actors in both public policy and industry. To close the loop exercising such practices in R+D projects and manufacturing efforts will be of crucial importance.

The concrete results of the ManVis Delphi survey are to be:

- Integrated into the long-term planning of the European research funding for manufacturing,
- Included in the debate on the Manufuture Technology Platform currently being developed and accessible at **www.manufuture.org** , and
- Published and disseminated among potential users in government, industry and the general public.

Further Sources

This foresight brief provides a summary of the results of the overall ManVis project. More complete information, detailed results and policy recommendations can be downloaded at the project website **www.manufacturing-visions.org**

Spanish Nuclear Energy Futures 2030

Authors:	Barbara Grunewald / barbara.grunewald@arcs.ac.at		
Sponsors:	OPTI - Observatorio de Prospectiva Tecnológica Industrial		
Type:	Single issue Foresight with a focus on nuclear energy		
Organizer:	CIEMAT - Centro de investigaciones Energeticas, Medioambientales y Tecnologicas Contact Juan. A. Cabrera / ja.cabrera@siemat.es		
Duration:	2004 to 2005	Budget: € 40 000	Time Horizon: 2030

Background

The purpose of this exercise was to identify the main technologies that would influence the development of nuclear energy in Spain up until 2030. The picked up information is supposed to help to change the public opinion in Spain from a sceptic view towards a broader acceptance of the application of nuclear energy.

From Acceptance to Scepticism

Nuclear Fission has been in use as source of energy for about 50 years. During the 1970s the Petroleum crisis led many countries to use nuclear power in order to satisfy the demand for energy at an acceptable price. In the 1980s accidents at Three Miles Island in the US and at Chernobyl in the former Soviet Union changed worldwide opinion on the safety of nuclear energy and created a more sceptical view of this energy source.

The Changing Perception of Nuclear Energy

Nowadays perceptions of nuclear energy are characterized by diminishing confidence in the safety and security of this industrial sector. The sceptical public opinion influenced the future of the energy sector. In Spain for example no more nuclear plants were commissioned and investments in the nuclear energy sector decreased. This was a accompanied by a loss of scientific competence in the domain.

Nuclear Energy Today

By 2004 there were 439 nuclear centres worldwide. These were situated in 31 countries and at that time the production capacity was estimated to be about 16% of worldwide energy needs. In the European Union alone 145 nuclear energy plants produced around 35% of all the energy needed. In Spain today nine plants meet about 23, 6% of our total electricity needs.

The OPTI-Report on Trendsetting Nuclear Technologies

The Energy Foresight exercise started in 1998 and was conducted through CIEMAT – the Centro de Investigaciones Energéticas, Medioambientales y Tecnològicas. CIEMAT was responsible for the energy agenda at the OPTI foundation. Three different exercises were carried out each year dealing with:

- Renewable energy.
- Renewable fossil fuels.
- Transport, distribution, storage and utilisation of energy.

To top off the agenda on future application of energy a 'nuclear energy' theme was added to the list and implemented in 2004.

The target of the nuclear study was to identify the main technologies supposed to influence the development of nuclear energy application up to 2030 and to discuss the constitution of a corresponding national consensus in Spain.

The results of the process are presented in the OPTI-report 'Energia Nuclear'.

Project Structure

To implement this foresight exercise an expert panel and a consultative panel were set up.

The expert panel was made up of 17 experts. Of these, 7 came from industry, 3 from university, 4 from research centres and 3 from public administration. The panel was required to identify relevant technologies for the future development of the nuclear energy sector. More specifically their goal was to outline the future of the nuclear energy sector by:

- Drawing a future scenario for the development of nuclear energy,
- Evaluating the expected position of nuclear energy,
- Analysing the contribution to gain electricity and reduce toxic emission,

- Identifying needed energy resources,
- Disclosing obstacles and offer solutions,
- Revealing the national position,
- Develop a corporate discussion to detect existing group consensus or extreme positions.

The panel identified 40 technology fields grouped under 6 headings of relevance for the nuclear energy sector. This information was used to set up a questionnaire for the consultative panel.

The consultative panel assembled 210 experts. 108 questionnaires where returned. This makes an average participation of more than 51%. Each identified topic received an average of 80 answers.

Consistent with their level participation in the sector 10% of the returned answers came from women. The average age of a participant was over fifty years and this too corresponds with the age structure of the sector.

Relevant Technological Trends

Topics were ranked according to their relevance and a variable 'degree of relevance' was established. With this variable an indicator was defined which allowed one to evaluate matching opinions of the consultative panel. The most relevant findings are summarized as follows:

1. **General Topics**
   This category contains socioeconomic and political assumptions related to the development of new technologies for the nuclear sector. The topics identified are not strictly technological but are important for the perception of nuclear power in the Spanish society. They have to do with issues such as the assumed total capacity for energy production, the option to reduce carbon emissions and public acceptance of technologies to reduce nuclear waste.

   Two of the identified relevant topics are related to:
   - Capacity.
   - Infrastructure and auxiliary services in the sector.

   The third was related to the need to initiate activities that would inform and develop public opinion about nuclear energy as a future energy option.

2. **Design, construction and management of nuclear power stations**
   The experts expected that during the next decades the application of nuclear energy to produce electricity will develop along two lines. One line will follow research to extend the lifetime of existing nuclear plants already in use. The other line is the development of future nuclear plants based on new reactor designs and incorporating passive safety features.

3. **Management of nuclear waste and decommissioning**
   Here the most relevant topics for the near future - a period spanning 2011 to 2020, were identified as the development of alternatives to the storage option for long term nuclear wastes and the development of methods for the evaluation and management of technologies for nuclear safety.

4. **Safety and protection**
   All topics grouped under this heading are expected to be developed before 2010. This was the shortest time horizon identified in the whole exercise. Globally these topics are of high priority and have high importance for the sector. The two most important topics are related to procedures necessary for the licensing of nuclear power plants and to legislation for the nuclear waste transport and management.

5. **Other applications**
   Accelerators for the production of radioisotopes can be expected as short term nuclear industry developments. The radioisotopes are typically intended for use in industrial production and in the medical sector. The most relevant long-term prospects however are for the use of nuclear energy in the production of hydrogen and other industrial chemicals. This research area is expected to give rise to whole new industry sectors.

6. **Fusion**
   One of the most promising topics of interest for international experts is the development of solutions to the question of how fusion can be used as source of energy. Magnetic Confinement Fusion uses strong magnetic fields to confine the hydrogen heated by microwaves to very high temperatures. Inertial Confinement Fusion or ICF is a radically different approach that uses high energy laser beams to compress and heat hydrogen fuel to the point where fusion occurs. The inertia of the fuel itself is used to confine it long enough for fusion to take place.

All the topics identified for their high relevance are related to the magnetic confinement. At present this scientific field is considered as the most promising approach on the basis of experimental results achieved so far.

With respect to inertial confinement only 13% of experts questioned are sceptical about the prospect of success or anticipate that the goal of igniting a fusion reaction to gain energy will 'never happen' in the long run.

This opinion must be clarified in the sense that international collaboration to develop relevant R+D programs does not yet exist for inertial confinement although they do in the case of the magnetic confinement approach.

The Challenge for the 21st Century - Increased Energy Demand coupled with Reduction of Emissions

One of the main technological problems of the 21st Century will be to meet expected demand for energy while maintaining the standard of living and level of economic growth to which we have become accustomed while at the same time reducing emissions associated with climate change.

Decisions regarding energy policy must be taken with due consideration for:
- Expected levels of consumption over the next decades,
- Available technologies and their state of readiness, and
- The ability to meet demand in a sustainable way.

Actions are therefore required to:
- Diversify the energy resources,
- Reduce the external dependencies, and
- Find an appropriate equilibrium between economic development and environmental protection.

The energy sector displays a series of future scenarios in which the different technologies join to meet demand and other anticipated requirements relating to technology, economic competition and the environment. A careful analysis of all these factors should be carried out before taking decisions on the energy objectives and the necessary investments.

A short Term Challenge - Changing Public Opinion

Experts agreed that in the short term from now until about 2010, it will be necessary to improve networking and communication between the technical experts in the sector, policy makers and the general public. This is essential to address the concerns of a sceptical public and create a more open attitude concerning the role of nuclear power and the necessity of public investment in new energy technologies. The public must be reached by activities that inform them of the advantages and disadvantages of available technologies.

Gaining Back Lost Capacities

A change in public opinion is not only needed to consolidate a positive perception of nuclear energy but also to find an appropriate response to the decline in human resources to work in the nuclear sector. The experts consulted also saw losses occurring in other domains using similar or identical technologies. They pointed to the need to take urgent action to attract new scientists and engineers to these domains.

Strategic plans should now be developed to give the scientific-technological system appropriate orientation to address future scenarios. It is desirable as much as possible for Spain to apply its own technologies to the solution of energy related challenges. Experts were of the opinion that Spanish society could be convinced that nuclear energy should be seriously considered as an option for electricity generation in the future.

A Positive Future

In the long term technological developments have to handle different problems relating to nuclear energy. Foresight exercises sketch different technology options that provide information on the present state of the sector and on its evolution. They indicate the opportunities, risks and obstacles that may arise. This information must be used to take strategic decisions analysing and comparing these outlooks to plan suitable projects for the future.

Extending the Lifetime of Existing Power Stations

Operators have an interest in extending the life-time of existing power plants. By means of new technologies and normative measures it is possible in principle to extend operational lifetimes by up to 40 years.
In the future nuclear power stations will incorporate new reactor designs, corresponding to an evolution from current light water reactors that incorporate technical advances as well as knowledge and the experience obtained in the operation of the present units.

In the distant future revolutionary new designs will implement new concepts that are currently in a stage of technological development and so it will be important to maintain a capability to evaluate their technological viability and to demonstrate their economic worth and their contribution to sustainable development.

Solution for Nuclear Waste

The solution to the problem of handling and managing highly radio-active nuclear waste on a long-term basis relies mainly on deep geological storage. It is important to analyze possible locations and develop the technologies that will guarantee a required level of safety over very long time-spans.

Partitioning and Transmutation

Although the technologies for partitioning and transmutation are in a preliminary phase of investigation experts expect that they will be applied in future to reduce the toxicity of nuclear waste. Eventually this will enable us to dispense with the requirement for deep storage. For now it is important to participate actively at EU-level in international initiatives that exist in this field.

A Safety Warrant

Safety and protection are activities fundamental to the working of nuclear installations. The long term effects of radiation and the effect if long-term exposure to low doses are examples of subjects that are important to investigate so as to evaluate the critical levels of exposure and improve security measures.

The Quest for New Energy Sources

Nuclear fission energy can play an important role in the development of the hydrogen industry. It provides a way of producing hydrogen in the quantities required by the energy industry. It is therefore capable of contributing to the development of an entirely new system of energy production. This possibility requires a strong response in terms of R+D.

Nuclear fusion shows up as a source of energy able to address different future scenarios for energy demand. On a time scale longer than 50 years fusion remains an important field for research and development to demonstrate its technological and economical viability.

Open Debate to Counter Scepticism

The present situation asks for an open debate concerning the future of the energy sector. A consensus must be found between policy makers, energy experts and the general public. All groups involved should be aware of the consequences of the decisions being made. Following the OPTI-Report such a debate should include:

- An analysis of the contribution of renewable energy to meeting expected demand,
- The necessity of continued use of fossil fuels, and
- The potential of nuclear energy combined with the challenge of its use to help reach the Kyoto target.

The last years have underlined a need to meet future demand for energy as well as the environmental and geopolitical challenges related to the curbing of emissions from fossil fuels. This situation has given new life to the nuclear option.

There is a need to develop an in depth open and public debate about the development of the energy sector that includes nuclear energy, its capacity to meet future needs in terms of demand and the fight against global warming. This is a necessary objective for politicians, experts and the general public.

Sources and References

http://www.ciemat.es/
http://www.opti.org
http://www.opti.org/pdfs/nuclear.pdf

'AGENCE FUTURE' Futures Conversations around the Globe

Authors:	Maya Van Leemput / agencefuture@skynet.be		
Sponsors:	Vrije Universiteit Brussel – Fons Pascal Decroos		
Type:	Futures Research		
Organizers:	Independent researchers - Maya Van Leemput and Bram Goots		
Duration:	1999-2003	Budget: € 300 000	Time Horizon: undetermined

Exploratory Research into Conceptualisations of the Future

Insight into the variety of everyday as well as specialist conceptualizations of the future is a necessary condition for mature and successful foresight practice. Agence Future or AF is a long-term project for basic exploratory research into the make-up and structure of concepts of the 'future', the use of images of the future and the possibilities for cross-cultural communication about futures. The project tests an innovative combination of approaches for futures studies, with the aim of contributing to the theoretical and methodological basis for foresight practice and to improving foresight capabilities.

Collecting Futures Conversations

Futures are much more multi-dimensional than mere use of the plural can convey. AF tackles the challenge this poses with a multi-faceted methodological approach and an open ended research design to create an analytical overview of the diverse ways people talk about the future.

AF's main objective is to bring together a diverse international collection of futures conversations. It asks how people from different walks of life and degrees of specialization can talk about futures more or less spontaneously and unprepared, with no guide-line other than the clear intention to discuss the future and a semi-structured questionnaire to help the process along.

Images of the future and futures thinking play a role in people's varying approaches to everyday reality and to their specialisations. How the future is conceptualized in these contexts, underlies the real possibilities for foresight and futures oriented action today. AF examines what people say about the future and how they say it. It undertakes to chart the characteristics of the logic and content of the futures conversations in its collection. The first stage of the project, presented in this brief, points out the wide range of possibilities for the ways people think and talk about futures. In the current second stage, the data collected is processed for presentation in a series of concept maps of the future.

The study also contains a set of methodological objectives. First AF tests interview schedules for futures studies by applying them in different cultural settings. Second, it tests the effects of combining methods from diverging fields of practice in social research design. Working in the fields of futures studies, journalism and visual arts with a single project design, AF offers an opportunity to asses the advantages and disadvantages of such an approach.

While each of AF's components has its own specific set of objectives, their combination aimed to provide opportunities for popularizations of futures themes and to encourage public discussion on foresight.

Academic, Media and Artistic Work

In the first stage of AF, field research over a **3 year period** from June 2000 comprising 382 conversations about the future were held in **30 countries in five continents**. A team of two - a scientist and an artist - developed the project independently and established a network of volunteer collaborators as well as corporate and non-profit sponsors. The project was conceived to combine its social research component with a media component and an artistic component. Project development and preparation for the field work took place in the UK, Belgium and Germany over a two year period prior to the start of the field research.

The academic research was overseen at the Vrije Universiteit Brussel (VUB) by the Social Research group (SOCO) in conjunction with the Study Group in Technological, Economic and Social Change and Labour Market Research (TESA), both of the Faculty of Economics, Politics, Sociology and Management School Solvay. Six-monthly reports kept track of progress made during the field research, summarizing the general conditions for the research in different locations, the numbers and types of conversations held, the most notable characteristics of the last series of conversations and the most common subjects of conversation. The **media** component of the project highlights questions about the future for a broader public. AF featured primarily in Belgian and German media. Material produced by the team during the fieldtrip was published in De Morgen, Vacature's Science & Technology and Akademos as well as on sponsors' websites and in their publications. Stories about the project featured in the Flemish national press, as well as national and regional publications in Germany and several locations included in the fieldtrip. Additionally, cycling related publications paid attention to the project and a series of slide-show presentations was held in Germany. The team made radio- and television appearances in Belgium, Germany and Norway. Most media attention was concentrated around three specific periods, the first at the start of the field research, then during a 3-months stay of the team in Belgium after the first two legs of the field trip and finally during the exhibition held in Antwerp 6 months after the first stage of the project was closed. Since then a follow-up project for which 36 interviews were held in Antwerp generated a new wave of media interest. Two thirds of the interviews conducted for AF were filmed and a DVD with interview excerpts was put together for the Futurescales exhibition at which the material collected during the fieldtrip was presented to the public. The interviews held in Antwerp 12 months later were used to produce a video-document that was presented at MuHKA_media.

During the research journey a website was kept up to date that reported on the team's progress on the road, it had a small but loyal audience. The creative and **artistic** component of AF is based on the experiment and adventure of a journey of exploration into the future during the first years of the new millennium. The research team did not just observe scenarios for the future, they participated in them, tested them out. In the first stage of AF, the team travelled with two recumbent bikes and high-tech equipment. They emerged themselves in their subject, searching for everyday, unexpected or unique perspectives on futures everywhere in the world.

The Fieldtrip

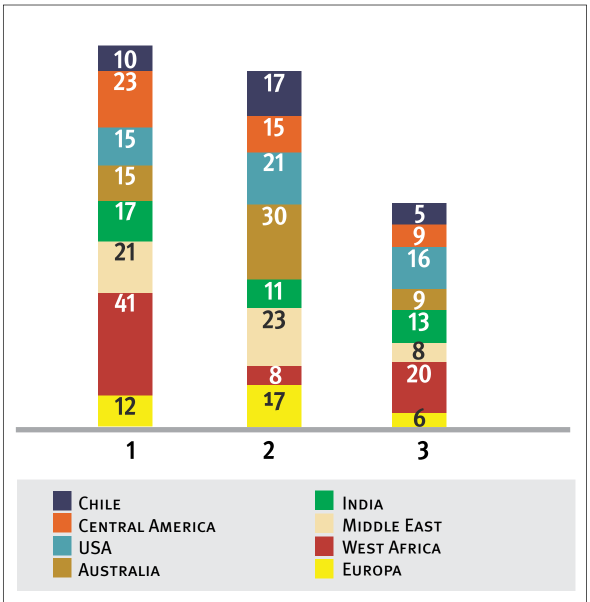
The following table provides a chronological overview of the first stage of AF, the countries included in the field research and the total number interviews held during each leg.

1998 – 1999	London	Development and Preparation
	Brussels	Publications in De Morgen
Oct 1999	Egypt	Pilot study, test ride and 8 interviews
June 2000	Belgium	
	Netherlands	
	Germany	
	Poland	
	Lithuania	
	Finland	
	Norway	
	Denmark	35 conversations and 6 experts
Oct 2000	London	
	Brussels	Publications in De Morgen
Feb 2001	Senegal	
	Mali	
	Burkina Faso	
	Ghana	69 conversations and 20 experts
Jun 2001	London	'Visions of the Future on Television'
	Brussels	
Oct 2001	Germany	
	Hungary	
	Turkey	
	Syria	
	Lebanon	
	Iran	
	Pakistan	52 conversations and 8 experts
Mar 2002	India	41 conversations and 13 experts
Jul 2002	Thailand	Background and Preparation
Aug 2002	Australia	54 conversations and 9 experts
Nov 2002	USA	52 conversations and 16 experts
Feb 2002	Cuba	
	Mexico	
	Belize	
	Guatemala	
	Honduras	47 conversations and 9 experts
Jun 2003	Chile	
	Argentina	32 conversations and 5 experts
Oct 2003	Belgium	Analysis and Development

Interviews and Orientation Conversations

Three different types of conversations were held. The first 'regular' conversation type consists of in-depth interviews following a semi-structured questionnaire. The conversation partners were individuals from 30 countries who did not consider their practice to have a specific futures orientation. In addition several kinds of orienting conversations were held. Questions from the questionnaire are addressed in the latter discussions, but not necessarily all of them and not in a specified order, room was made for additional questions. Orientation conversations were held with some of the first contacts made in each country as well as during chance encounters with passer-by and street-interviews. In-depth interviews with experts that apply a specific future orientation in their daily specialists practice make up the third group of conversations.

The interviews were held in 30 countries divided into eight groups. AF brought together a total of 382 conversations about the future. 154 conversations took place with respondents selected to include people with no previously known interest in futures topics. 86 were with experts in fields explicitly or implicitly related to futures. The following figure shows real numbers of interviews in each of the eight legs of the fieldtrip. Columns 1, 2 and 3 show the regular, orientation and expert conversations respectively. The researchers approached respondents directly and talked with them in their own settings. In selecting respondents a degree of stratification as to age, gender, class and ethnicity was applied. This approach benefits the media component of AF but is not representative for any of the population groups featuring in the collection and cannot be attributed analytical power.



Personal, Local and Global Futures

When people are asked to talk about the future, there is a wealth of possible ways in which they might respond. Respondents can in principle say anything, talk about any aspect of future life, discuss any topic, location or time. This overwhelmingly open research question was tackled by using a standard semi-structured interview schedule that could be adapted to individual respondents but always uses the same basic approach. The principle is to have people react first to the introduction of the idea of futures with as little input from the researcher as possible. Then respondents are asked to talk about personal, local and global futures. For each of these scales best and worst case possibilities as well as expectations are explored. In the last section of the interview, conversation partners are asked to represent an image of an extremely long term future. To close the interview they are asked to indicate where in their country the future could already be visible today.

The material was gathered so that it would include unique, exceptional and original approaches to the subject matter of the conversations. With such a wide ranging group of respondents, the formulation of questions in the questionnaire could not be the exactly the same in each interview. Respondents needed to be able to make suitably considered statements. Each of them needed to be able to make sense of our questions, and give replies that could be understood by the research team. This is an aspect of strategies and techniques applied in the interviews as well as a more general question of cross cultural communication.

Time, Geography, Uncertainty and Change

To describe and compare the conceptualizations of the future that appear in the conversations, AF takes into account different characteristics of these conceptualizations. Results from the ongoing analysis are being published in peer-review publications as well as popular media and serve as a basis for the concept maps that are being developed.

In its analysis AF distinguishes between conceptualizations on the future in the realms of the private, professional and public spheres. Conceptualizations of personal, local and global futures are examined and their make up compared. Distinctions between common sense, everyday types of discourse on the future and specialist conceptualizations are apparent in the collection. Conceptualizations in which questions concerning the future are considered relevant and important and those that consider them irrelevant and unimportant are described. Interpretations of progress, change and development apparent in the conversations are examined in detail.

Atypical Conceptualisations

The analysis of the data gathered is still ongoing. Nevertheless, findings concerning the **combination of methods** from different fields of practice and the nature of conceptualizations of the future have already been reached over the course of the first stage of AF. The unconventional combination of methods in AF has had a definite impact on the execution and results of the project. Different fields of practice offer different perspectives on the object of study as well as different motivations for questioning the object at all. Scientists often work in/for/with the fields of business or governance and such cooperation has more to offer than mere funding. It brings specific questions and points of view to the research design and implementation. AF demonstrated that combinations with other fields of practice such as journalism, the arts or design can bring up other questions and points of view. The research does not provide **generalisations** on the views and opinions of specific populations or categories of respondents but shows the variety of possible approaches to the subject of futures. In presenting its findings AF highlights the typical as well as exceptional, highly original and unexpected responses to the questions in the interview schedules.

It is not within the scope of the research however to make general verifiable statements for instance on optimism and pessimism of certain population groups or on the factors that contribute to this optimism or pessimism. Instead the analysis concentrates on the combinations of characteristics that optimist and pessimist conceptualisations display. Some **themes** such as **labour** and **geo-politics** appeared in all three parts of the conversations held with AF.

On the personal scale and the local/regional scale, **education** and the role of national and **international politics** featured prominently. Perhaps surprisingly **science and technology** were emphasized primarily by experts involved in these sectors. Only a minority of other respondents pointed at their role as drivers of change and they have been mentioned only occasionally as objects of change. On the other hand, **material infrastructure,** from ICT to road networks and housing, appeared frequently in the conversations, both as motors and as objects of change.

Religion did not appear as either an object or motor of change in any of the European conversations but in West-Africa, the Middle East and the US, the theme received a lot of attention.

While interpretations of the need for **change** have been varied, optimism about the direction of change was greatest in those cases where uncertainty on the short term was most explicit. Many expert as well as lay conversations in the Southern hemisphere tackled interpretations of **development**. Respondents have talked both about motors of development such as the economy, geo-politics and national politics as well as the desired outcomes. While most respondents equated development with progress, some expressed doubts about the meaningfulness of **progress** in domains such as warfare and medicine, as long as it takes place without reference to progress necessary in domains such as equity and sustainability.

The make-up of conceptualisations of change, development and progress is the subject of ongoing analysis of the material gathered with AF. As part of the overview of the scope of the conversations, the periods of **time** respondents mentioned in the conversation were tabulated. The future could be any time beyond now, but in daily life people think about the immediate future more often than about a time beyond the life time of say our unborn grandchildren. After looking at what period of time people talk about spontaneously, AF concentrated on ways people deal with questions about time ranges beyond those immediate horizons and their own life time. People's conceptualisation of the future most often does not concern a precise 'point in time'. People discuss a certain time span, rather than a precise moment. Usually certain events or processes are central to the discussion and it is the location of these events and processes 'somewhen' in the future that determines the time scope of the discussion. This has been a challenge to code for analysis. Lists of different interpretations of time horizons have been drawn up that indicate that personal or family time does overlap in part with political and scientific time but that it is experienced quite differently.

Media Coverage, Public Discussion and Concept Map Preparation

AF's outputs that derive primarily from the media component of the project include almost 100 print media articles, more than 20 radio and television discussions on the project, the website, an exhibition and two DVDs, presented in an art-gallery and the Museum of Contemporary art in Antwerp. The outputs of the academic work include several peer-review articles as well as materials for workshops and seminars. The presentation of concept maps is to be prepared by November 2007. AF has succeeded in bringing its subject matter to a broad non-specialist audience in Belgium and Germany and has also received attention in several locations included in the fieldtrip. It has stimulated public discussion on foresight in several contexts in Flanders and elsewhere. Opportunities are sought to present the finalized analysis and concept maps in policy contexts. These are intended to provide insight in the foresight capacities present in individuals and the potential of the combination of different fields of practice to inform the set-up of participatory foresight for policy development.

Sources

Glenn, J.C. and Gordon T.J.: 2003 State of the Future. ACUNU millennium project publication, Bell, W. (1996), Foundations of futures studies, Volumes I + II: Rutgers NJ, Transaction Publishers. **Balsiger, P. W.:** Supra-disciplinary research practices: History, objectives and rationale. Futures, 36(4), pp. 407-421. **Stevenson, T.:** Anticipatory action learning: conversations about the future. Futures. 34, pp.417-425. **Van Steenbergen, B:**. Hoe stellen wij ons de Toekomst voor? Verslag van een internationaal onderziek. Katern 2000. No. 6.
Don't forget to visit the website at **www.agencefuture.org.**

The Region of Lecco Industrial System 2015

Authors:	Riccardo Vecchiato / riccardo.vecchiato@polimi.it		
Sponsors:	Regione Lombardia		
Type:	A regional foresight exercise on the industrial system of Lombardy		
Organizer:	Fondazione Rosselli		
Duration:	2003 - 2004	Budget: € 60 000	Time Horizon: 2015

Background

Funded by Regione Lombardia and implemented in collaboration with Technocora, this initiative takes up where the EU-funded FoMoFo projet left off in 2002. The title 'FoMoFo' is a reference to the Four Motors of Europe, a group of highly developed regions that drive European industrial production. Along with Baden-Württemberg in Germany, Catalunya in Spain and the Rhône-Alpes region of France, the Italian region of Lombardy counts as one of the four motors. This article reports on an initiative that builds upon the FoMoFo foresight pilot to develop a deep understanding of the future for industrial production in the Lecco region of Lombardy.

Lecco – Between Globalization and Entrepreneurship

The first experiments with foresight in the early 1990s were national in scope and focused on themes of technological innovation. Since then the foresight approach in terms of its theoretical formulations and operating practices, has gradually diversified and been enriched. In a move from a national focus to a focus, it is routinely applied to the needs of the region at sub-national level, and as in the case of the FoMoFo pilot, it may be supra-national in dimension. In terms of subject matter it tends to go beyond technical-scientific topics to address broader economic and social issues such as mobility, population ageing, crime and immigration.

The regional government of Lombardy has been a pioneer in experimenting with foresight. It has commissioned an exercise that focuses on the question of the internationalisation of businesses in the Lecco area, particularly for the case of Small and Medium sized Enterprise. This issue is explored in the context of the long-term evolution of the various components and aspects of Lecco society.

The basic motivation of this initiative lies in the fact that the entrepreneurial fabric of Lecco will internationalise in a variety of different ways. This will mean changes to the location of their activities, choices for the geographical destination for their products and services, changes in their relations with local economic partners. These changes will have a range of different impacts on the economy of the province. The determinants of such change lie at various territorial levels – Europe, Italy and Lombardy as well as Lecco itself.

It is clear that factors and processes such as demographic trends, migration, labour market regulations, the structure and rules of international trade, innovations in manufacturing, design and company management technologies, particularly in the ICT field, skills required by the technological and organisational processes of manufacturing, and standards related to the protection of the environment, conspire to establish the context for change, will significantly influence the way Lecco-based businesses are structured and organised through the territory, and will have an impact on their process of internationalisation.

One has however to bear in mind that the internationalisation of the provincial economy embraces not just local firms but all firms with a local presence. Foreign operators whose decisions regarding their activities located in the Lecco area are conditioned to a great extent by their global strategies and these will have an impact on the local framework as well.

The effect of these factors and of the changes they produce in the economic, social, cultural and institutional field is not uniform, deterministic or certain. It depends also on actions to be taken by local social forces, both public and private, to achieve specific goals and strategies. It is therefore necessary to formulate strict hypotheses regarding the scenarios that may emerge for the institutional, economic and social systems of the province of Lecco, on the basis of which businesses will embark on the process of internationalisation. Even if the actual implementation of these scenarios, depends largely on the decisions and actions of forces from outside the province, understanding the possible alternative trajectories will enable the Lecco Provincial Council to define its own strategies and to interact proactively with other local and national governmental bodies, taking decisions jointly, coordinating and integrating the actions of all.

The Overall Foresight Process

In operational terms this exercise was tackled in three main stages:

Stage I: Pre-Foresight

In this case the term pre-foresight refers to the operational programming of the exercise. The main steps were as follows:
- Identification of the stakeholders to involve,
- Specification of the crucial factors and processes on which to concentrate the perspective analysis,
- Selection of the Foresight methodologies to use,
- Identification of the experts to involve,
- Collection of basic documentation.

Stage II: Foresight

This refers to the analysis of future options and mainly consisted in the building of alternative scenarios for the future of business in the Lecco area.

Stage III: Post-Foresight

The most important element for the region is to use the results of the foresight exercise as an input for the formulation of policy. It is important to include these steps in the overall planning of the foresight exercise to ensure a good link between the execution of foresight and the eventual exploitation of foresight in policy making processes.

Assessing the Structure of the Manufacturing System

First of all, a preliminary systematic analysis was carried out based on existing literature on the subject including scientific publications, economic magazines, daily papers, other texts and reports. This made the creation of a picture of the current structure of the manufacturing industry in the Lecco area and its level of internationalisation possible.

Secondly, it was possible to identify an initial group of drivers. A preliminary list of drivers was discussed at an interactive workshop with the experts. The list was extended and modified on the basis of their suggestions. Drivers characterised as being both highly relevant and uncertain provided the basis for the development of scenarios for the internationalisation of SMEs in the Lecco area. The following basic drivers were selected:
- The composition of the industrial system of the Lecco area in terms of the share of large enterprise and emerging sectors.
- The regional infrastructure in terms of roads and railways linking the local area with other Italian regions and with foreign countries.

By combining the extreme configurations outlined for these basic drivers, the project team obtained four scenarios for the socio-economic system of the province of Lecco.
- **Scenario A** assumed a significant evolution of both regional infrastructure and the system for local industrial production.
- **Scenario B** assumed the perpetuation of the current composition of the industrial system based on the prevalence of small and medium sized enterprise with a low level of integration, and the upgrading only to regional infrastructure.
- **Scenario C** assumed the perpetuation of the current model and state for both the industrial system and the infrastructure system.
- **Scenario D** assumed the evolution of the local industrial system and the maintenance of the infrastructural one

Within the four scenarios, it was possible to define articulated, consistent pictures of the other drivers for the macro-areas of Science & Technology, the structure of the industrial system in Lecco, individual and social values, population and the labour market, and therefore to identify the main characteristics of the internationalisation of manufacturing SMEs in the Lecco area.
Afterwards, the various aspects of the development of the industrial system of Lecco SMEs in the scenarios were outlined, considering in particular its competitiveness at an international level. As an example, here is reported a brief description of the results achieved for the first scenario, under the hypothesis of the high development of the local infrastructure system and the persistence of the current composition of the local industrial system, largely based on SMEs in traditional sectors.

The Evolution of the Lecco Industrial System

In the Lecco area local authorities provide effective support to businesses accessing European and non-European markets in terms of:

- Economic diplomacy,
- Development of infrastructural transport and communications networks,
- Support for innovation and R&D, and
- Protection of Italian products.

Territorial marketing and effective promotion of the 'Italy System' helps to provide greater visibility and greater acceptance of Italian products in high tech sectors.

In many cases however support policies and opportunities to expand into international markets are not exploited by Lecco businesses. Exploiting such opportunities often comes down to expanding a direct presence in outlet markets, with a local presence and direct control of the final activities in the value chain, in other words, distribution and service to customers in the pre-sale, sale and after-sale stages. For example, in the field of instrumental goods and in 'business to business' sectors in general, direct control of the end markets requires participation in the design stage and therefore in the customisation of products as well as in the provision of after-sales service.

An alternative to opening company sales branches is to form partnerships and integrate with foreign businesses. First of all this requires the identification of reliable partners, capable of offering a level of service high enough to maintain the integrity of the offer, particularly in higher market brackets. On the other hand this often requires the company to forego higher profit margins. In the absence of direct relations with the final customer, the Lecco-based company risks losing expertise in terms of its capacity to grasp the customer's requirements and customise its offer, as well as possible upstream integration of foreign partners that could emerge as new competitors.

Therefore companies that successfully grow in size and achieve complementary integration in a network organisation, create the conditions necessary to pursue international strategies that are more sensible and more sustainable in the long term, repositioning themselves strategically in higher market brackets, and differentiate their offer from the low quality, low cost outputs of competitors in newly industrialised countries, in particular in China.

To this end the modernisation of the telematic and transport infrastructure within the territory of the province, as well as the creation of large trans-European networks paves the way for more effective, efficient coordination of various business activities, in particular of logistics and distribution.
However, few small businesses in the Lecco area pursue such strategies of internationalisation. Especially if they are not already part of a network organisation. This is because they are severely hindered by their short-term approach, the lack of resources available to take advantage of new market niches and limited control over their distribution channels. The internationalisation initiatives of these businesses are of limited significance, because of the numbers involved and the nature of the strategies adopted with a sporadic, fluctuating approach. These initiatives are directed above all at the option of relocating activities with the greatest environmental impact and/or the largest manpower requirements to Eastern Europe or Asia. This is done with a view to reducing the cost of manufacturing factors and processes, effectively producing goods in these countries simply for resale in traditional markets.

Although important for the medium to high market brackets, containing the cost of manufacturing factors alone is not sufficient to overcome fierce international competition, especially competition from emerging countries, which enjoy an unequalled cost advantage with respect to Europeans.

Companies that focus only on reducing costs will experience great difficulty in the year ahead. This is true especially in the case of standardised products that are easily imitated or replaced.

Companies that ignore opportunities of growth and expansion into international markets, but implement advanced strategies based on innovation and the upgrading of products, may still manage to defend and consolidate their position. They may also maintain their share of the traditional markets. Customer loyalty can be maintained by the application of ICT. This is all the more important for companies that do not have branches outside their territory of origin and which are therefore unable to have direct contact with their foreign customers.

Guidelines for Policy-makers

Scenarios based on the hypothesis of the high prevalence of small and medium enterprises operating in traditional sectors and the lack of development of road and railways infrastructure represent one extreme in the evolution of the current situation.

Scenarios based on the hypothesis of deep restructuring of the Lecco industrial system, in terms of both composition of businesses and basic sectors provide preferred long-term visions for the region.

Instead of outlining for each of these scenarios the most effective policies and strategies for the main local stakeholders, the project team considered it more useful to determine strategies and plans that different stakeholders should pursue in order to avoid decline represented by the first extreme scenario, and in order to move towards the preferred outcome.

On this basis suggestions for policies and strategies were designed, presented and disseminated as outputs among the main local stakeholders of the project. In most cases these are local governmental bodies and local enterprises.

At this stage, it is too early to evaluate the real impact of the project on the policies of stakeholders. Nevertheless long after the project was finished the foresight team received requests for further explanations as well as invitations to meetings with large local stakeholder participation. In this way the foresight team knows that the foresight exercise has served as a real input to policy and has been taken into account in local policy processes.

Sources

www.fondazionerosselli.it

Greece's Path to the European Knowledge Society

Authors:	Tonia Damvakeraki / damvakeraki@atlantisresearch.gr Effie Amanatidou / amanatidou@atlantisresearch.gr		
Sponsors:	The European Foundation For The Improvement Of Living And Working Conditions. Timo Kauppinen / Timo.Kauppinen@eurofound.eu.int		
Type:	EU foresight on knowledge based societies with a focus on three countries - Finland, Germany and Greece		
Organizer:	PREST at the University of Manchester in the UK: Denis Loveridge / denis.loveridge@mbs.ac.uk Ian Miles / Ian.Miles@man.ac.uk Rafael Popper / Rafael.Popper@man.ac.uk.; ATLANTIS Consulting S.A., Thessaloniki, Greece: Effie Amanatidou / amanatidou@atlantisresearch.gr ; EMPIRICA GmbH, Bonn, Germany: Werner Korte / Werner.Korte@empirica.com ; FINLAND FUTURES RESEARCH CENTRE: Jari Kaivo-Oja / Jari.Kaivo-oja@tukkk.fi		
Duration:	2001 - 2004	Budget: € 34,800	Time Horizon: 2015

Background

In the context of its four-year work programme, Analysing and Anticipating Change to Support Socio-Economic Progress 2001-2004, the European Foundation for the Improvement of Living and Working Conditions launched EUFORIA - a project on 'European Knowledge Society Foresights (KS foresights) for living conditions, working conditions and industrial relations'. The purpose was to understand the 'drivers' of the Knowledge Society and to anticipate their potential impact on living and working conditions and industrial relations. The underlying aim was 'to identify and support paths to positive transformation while avoiding unsatisfactory development paths'. Especially in the case of Greece the development of a knowledge society is considered a major challenge due to the country's lagging behind in terms of technological development and the knowledge society indices.

Towards a Knowledge Based Society

EUFORIA was launched with the aim of:

- Identifying and analysing drivers of the Knowledge Society in order to understand the transformation from the Industrial Society to the Knowledge Society.
- Anticipating the scope of this transformation in order to analyse its impact on living conditions, working conditions and industrial relations.
- Helping decision-makers to identify positive trends to support as well as pitfalls to avoid.

EUFORIA included in its approach, a series of detailed pilot foresight exercises in Finland, Germany and Greece that were intended to identify the degree of advancement of a Knowledge Society in each country and major trends characterising the country's course of development, as well as to formulate specific scenarios for paths towards the Knowledge Society. The Knowledge Society and the Lisbon objectives are goals to be attained in a European context of ageing populations, low birth rates and different educational and organizational systems, some of which may not be well suited to knowledge diffusion and exploitation. In add to this Europe presents a great variety of economic environments, labour markets as well as working and living conditions. It is clear that novel approaches are needed that combine the rules of the free market with social and economy and responsibility. These are the primary challenges for Europe along with the creation of conditions necessary to ensure sustainable development.

The 'Knowledge Society' is still a vague concept: Different interpretations fit different socio-economic environments and despite discussions held with Greek experts and with others at European level, a common definition does not yet exist. Knowledge may be clearly defined but when it comes to knowledge-based society or economy and even more to a way towards the development of such a society, a clear and commonly accepted definition may be more limiting than useful and so it is doubtful whether a commonly accepted definition can, or even should be reached.

Each Nation follows its own specific path: The EUFORIA project indicates that different paths can be followed for the development of a country. That different degrees of development exist among countries does not necessarily mean that paths taken in the past were wrong. Nevertheless a path followed that does not allow for the positive integration and exploitation of the country's culture, specificities and strengths is not an effective one.

In this framework, different models of the Knowledge Society can be developed. The Knowledge Society is not dependent only on the use of ICT or the presence of high-tech sectors in the economy. While these may facilitate the development of a knowledge economy, a series of other factors should be in place such as education, training and organisational systems that promote the creation and diffusion of knowledge, as well as working and living conditions that require the advancement of knowledge and the intellectual development of citizens.

The Main Challenges to be Faced

An analysis of the current situation based on EUFORIA Knowledge Society 'advancement' indicators indicates that Greece lags among the EU member states and ranks far below the EU-15 average on nearly all aspects of the Knowledge Society.

Greece - a typical Mobile Phone Society: Like most Southern European countries, Greece has very high rate of mobile phone usage but very low internet access figures. Use of the internet however is expected to rise due to decreasing costs and the provision of specific public services such as TAXIS net as well as through measures of the Operational Programme for the Information Society which reflects a major emphasis given by Greece to the creation of the Information Society.

Education not Meeting Market Needs: Education systems gradually change with the introduction of new technologies, especially information technologies. The biggest problem faced by the educational system in the development of a knowledge society is the lack of long-term planning and the lack of coordination with market needs. This was highlighted in the latest policy documents in Greece along with a need to promote life-long learning and vocational training. That part of the Greek workforce that has received tertiary education (25-64) in Greece is close to the EU average as is the pupil/teacher ratio especially in primary and secondary education.

Catching-Up: In 2002 Greece was considered one of the fastest developing economies in Europe. Since 1995 GDP growth has been over the EU average as has the growth rate for labour productivity. For most of the 1990s, the growth rate of 'knowledge intensive' investments such as RTD, software and university education was one of the highest in the EU. RTD intensity though lowest in the EU in 1999, has experienced the highest average annual growth rate in Europe since 1995. Business financed RTD as a percentage of industrial output was also lowest in Europe in 1999, but it too experiences one of the highest average annual growth rates in Europe. Similar claims can be made about the number of researchers and new PhDs as well as the number of scientific publications, EPO and USPTO patents.

Advanced Technologies in Education: Despite these high growth rates, the starting point is often very low and Greece remains in the low position compared to the rest of the EU Member States. The international competitiveness of Greece still lags behind not only 'highly developed' countries but some of the newly associated EU states. On the other hand the Technological Achievement Index places Greece among the 'potential leaders' in 2001. Greece has a long way to go in exploiting the opportunities offered by ICT, the provision of enabling factors such as network access, network policy, networked society and networked economy, as well as in tackling general scepticism concerning the internet and doing business on line.

Skills and Employment Suffer from Digital Divide: A high level of unemployment coupled with the limited flexibility and adaptability of the labour market, as well as limited provision of and participation in vocational and self-training activities are areas that need attention. The same applies for the 'digital divide' issue as well as for income inequality, low birth rates, ageing of the population and the increasing number of immigrants that are not fully integrated in the Greek society.

EUFORIA Greek National Centre

It was decided at the start of the project to create a **EUFORIA National Centre** including representatives and stakeholders from all the areas examined under the project. This Greek National Centre consisted of representatives of the General Secretariat for Research and Technology at the Ministry for Development, The General Confederation of Workers of Greece, as well as the Industrialists' Association from Northern Greece, Researchers, Scientists and Academics. A first consultative round aimed at i**dentifying the major trends** characterising Greece's development and formulating specific Delphi statements. Assistance was also sought for the identification of other experts according to the specific requirements of each workshop and the **Delphi Survey**. For the identification of these trends a **SWOT analysis** was also implemented. A second round of consultations aimed at developing **specific scenarios** for possible paths towards the Knowledge Society. The **Delphi survey** was advertised during the International Foresight Conference that took place under the Greek Presidency at Ioannina in May 2003 and ATLANTIS members attended all the conferences organised by the **National Technology Foresight Programme** to keep track of progress and anticipated results, to ensure synergies between the two initiatives. Members of the Greek National Centre offered further support for the dissemination of EUFORIA results and their combination with the results of the National Technology Foresight Programme.

Socio-Economic and Technological Trends for Greece

Some of the most important **socio-economic and technological trends** identified for Greece are as follows:

- **Education:** The Greek system is not built around the 'idea' of lifelong learning or knowledge management and creativity. This results in the production of 'less competitive' graduates than other countries. The development of private non-profit bodies for the provision of higher education could increase competition, improve the quality of the education in public universities and orient them towards the fulfilment of market needs in terms of specializations and skills.
- **The Ageing Population and Retirement:** The ageing of the population is linked to the ability of the public health system to cope with increasing demand for health care and medical treatment. A constantly increasing retirement age in combination with possibilities for part-time occupation will result in the appearance of new forms of work after the age of 60 or 65 - part time occupation in the same field, as well as 'alternative' or 'social-voluntary' occupation. Some people may continue working. This life-long working will be supported by lifelong training. Others may be excluded from work after the age of 50 for a variety of social reasons. This may result into the appearance of new categories of employees, unable to be insured or retired.
- **Peripheral Disparities:** Peripheral disparities in Greece hinder balanced development of the Knowledge Society. Large urban areas will develop faster because of their better infrastructure and access to human resources. The rural, mountainous, frontier and island areas will lag in their development. The unbalanced 'territorial' distribution of people of different ages and incomes will lead to unbalanced development of the Knowledge Society in Greece. Alternative forms of tourism in some rural and mountainous areas could lead to the development of poles of attraction not just for tourists but for tele-workers, boosting quality of life in these areas.
- **Industrial Relations:** Industrial relations and working conditions in Greece do not promote the development of the knowledge society and the economy.
- **Quality of Life:** Changes in the type of work and working conditions related to the Knowledge Society will cause changes in the personal life-styles and family structures. Our society has become a 'show-off' society in the sense that what is not promoted has no value. Mass media contributes to this by creating consumer models based on 'fictional' needs. This may hinder the development of the knowledge society.
- **Economic Factors:** The 'dualism' that characterises the Greek economy will be intensified as competitive enterprises constantly improve their performances at national and European level, while 'traditional' and less competitive ones struggle to survive. The development of new peripheral markets in the Balkans, Eastern Europe and the Mediterranean may alter the orientation of the Greek enterprises. Some will exploit availability of cheap labour to become more competitive. Others may cover 'non-competitive' markets that can be served by products and services of low quality. These strategies run against the trend of the emergence of a Knowledge Society.
- **Governance Policies:** The 'conservative' organizational culture characteristic of areas in Southern Europe and in Greece will widen the 'distance' between management and employees, hindering timely exchange of information and the production of knowledge. On the other hand e-governance enhances transparency in the procedures concerning the relationship between the citizens and the state and may contribute to the decrease of the population moving to the urban areas.
- **Data Security:** The use of new technologies is restricted by concerns of civilians regarding the protection of their personal data, their right to privacy especially at work, the inadequacy of the legal framework concerning IPR protection and a tendency towards political control of the information.

The Drivers of Change

The key issues raised with relevance to policy making are as follows:

- Greece should invest more in the field of **human resources.** Special emphasis should be placed in the differentiation and quality of products and services, education and training, health and tourism through the application of new technologies that will help improve competitiveness and quality of life so that quality of life.
- Innovation should be promoted as a major political target and as a major pre-requisite for development at all levels – the state, the economy and society. The creation of an **environment conducive to innovation** and entrepreneurship that shall favour the development of new ideas and risk-taking should also be promoted.
- It is necessary to promote the **collaboration between research and industry.** This could be achieved by adjusting the way knowledge is produced, used and diffused by Research and Educational institutions as well as enterprises and organizations, according to the characteristics of a Knowledge society; this way,

the demand for training and life-long learning will be initiated from the 'basis' and the 'supply' shall meets the market needs.

- The **social partners** should reconsider their role. They should consider new emerging forms of work and types of employees and strengthen their participation in the formulation of work related policies.
- All **the ministries** should engage in the coordination, evaluation and control of the effectiveness of their activities and the measures and actions taken in all policy fields in the pursuance of the commonly agreed vision.
- The **private sector** should reconsider their role in terms of responding to the growing importance of innovation and differentiation of products and services to preserve and strengthen their competitive advantages.
- Measures should be taken for the positive **integration of the immigrants** and foreigners in the Greek society.
- The **Greek Diaspora** as well as foreign and local investment can play an important role as a resource to attract business and scientific resources located abroad.

A Greek Awakening

The drivers and trends that characterise the development of Greece are not all contributing to the emergence of a Knowledge Society. Nevertheless one possible future scenario that has been identified is the optimistic 'Awakening' scenario, although it is unlikely that this scenario will unfold until before 2015. This development path is characterised by an 'awakening' of the Greek state and Greek society to the understanding that growth is not going to last unless the conditions to ensure sustainability in development are in place, and until a new orientation is defined and followed. An 'aggressive' and commonly agreed vision for an 'awakened' Greece in 2015 needs to be developed based on the concept of quality of life, which has to be integrated in every-day living. This model of a Knowledge Society requires a re-orientation of policies, careful design and ensured effectiveness of measures. It will require radical social change and strong political will. Although it was considered the least realistic in terms of realisation till 2015, it was also believed to be the one that would put Greece on the path of sustainable development.

EUFORIA and the Greek National Foresight Programme

The EUFORIA initiative in Greece was fortunate to run in parallel with the National Technology Foresight Programme. Although different in scope and orientation, this managed to raise interest in the use of foresight exercises among the members of various 'expert' communities. The decision to use the National Foresight Programme scenarios as one set of inputs for the EUFORIA scenarios and to include in the national EUFORIA expert team, people directly involved in the National Programme, resulted in achieving substantial synergies between the two programmes and increasing the impact of EUFORIA. The EUFORIA report for Greece was presented to all the members of the work groups of the National Foresight Programme together with other presentations about the Knowledge-based Society and Economy. It was taken into consideration as part of the basic documentation prepared for two new 'horizontal' working groups in the National Foresight Programme – 'Science and Society' and 'e-Governance'.

Sources and References

EUFORIA Greek Final Report 2004 by E. Amanatidou, T. Damvakeraki and F. Psarra.

The Household Horizon 2012

Author:	Werner Reutter/ werner.reutter@rz.hu-berlin.de
Sponsor:	Institute for the Future, Silicon Valley, Ca. (USA)
Type:	Field/sector specific – covering all S & T fields
Organizer:	Institute for the Future – IFTF, info@iftf.org; Andrea Saveri, asaveri@iftf.org; Kathi Vian, kvian@iftf.org; Lyn Jeffery, ljeffery@iftf.org.
Duration:	2003 — Budget: N.A — Time Horizon: 2004-2012

Purpose

Based on in-depth research on selected domains the Institute for the Future predicts major changes in household behaviour. These changes will, for example, materialize in new ways how we will adequately manage: information work, social networking, mobile life, and identity creation. The change of these and other daily routines and practices of a household will trigger innovations in products and services thus creating new markets and opportunities for companies. The report The Household Horizon: A Guide to Technology and Daily Life in 2012 presents major findings of the study and introduces a framework for analyzing technological shifts and their impact on household behaviour.

Drawing a Map about the Household of the Future

In order to develop innovative products and explore new markets, businesses have to act upon future needs and demands of households yet unknown to them. However, predictions about middle-range or long-term developments are facing a triple challenge: they have to make forecasts about technological shifts, about behavioural changes, and about the way how these two aspects are interacting with each other. Based on a complex and sophisticated framework that takes these difficulties into account the report predicts major shifts on the household horizon: technological changes will fundamentally affect life and behaviour in the household of the future.

The Problems

The report The Household Horizon: A Guide to Technology and Daily Life in 2012 is tackling with the aforementioned problems and gives answers to two basic questions:

On the one hand, drawing on its technology research the IFTF forecasts major changes on the technology horizon affecting the health economy, manufacturing paradigms, the leisure industry, etc. The first crucial question the report has to tackle with, concerns, hence, how these technologies and other important innovations will alter purchasing patterns and preferences of individuals and household consumers.

This question can only be answered if one goes beyond mere predictions about technological innovations or what kind of services new technologies may offer to customers. In order to explore new market opportunities and respond to evolving demands it is necessary to take the fact into account that we adjust new technologies to our individual life and needs. To put it differently: New technologies may define future demands, but we also define the use of new technologies by developing new needs. In short: we re-contextualize technologies and use them in ways nobody imagined beforehand. For example, ten years ago nobody conceived that the Internet could become be a major source for downloading music. In consequence, companies that strive to succeed in new markets not only have to make sound predictions about technological innovations, but also about the way households will frame the use of these new technologies.

On the other hand, the accuracy of these predictions depends on a method that takes these complex relations and interdependencies into account. It is, hence, not the lack of data that makes forecasts difficult and often a risky basis for designing business strategies. In fact, surveys and interviews made by the IFTF provide thousands of clues about future household activities, relationships, and spending patterns. But in order to make sense out of these data a framework is required. What is needed is a method to analyze systematically these data and clues and put them into the proper context. The IFTF provides such a framework in form of a compass that helps to navigate through a landscape still unknown to us.

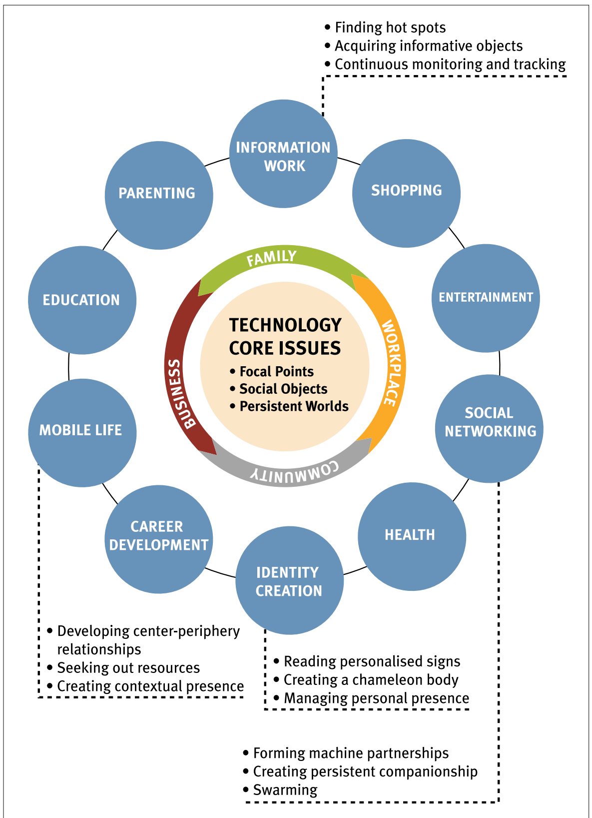
Mapping the Household Horizon: the Framework

The Technological Compass for Understanding Daily Life is a means that addresses three aspects:

- It first depicts the ways how we adjust and "re-contextualize" technologies to our daily needs and demands (technology adoption).
- Second, it provides insights into the way how households interact and change on a daily basis (in-depth view of the household).
- Finally, it describes the way how new connective technologies will shape activities and routines in a household (connective technology landscape).

The framework developed by the IFTF is a four-layered tool that links:

- Technological core issues,
- key players in household interaction,
- domains in household activities, and
- daily practices.



Source: Institute for the Future

Figure 1: A Technological Compass for Understanding Daily Life in 2012

Changes in the technological core issues (inner circle) will affect how key players (family, workplace, community, and business) will act in different domains of household activities (social networking, entertainment, mobile life etc.), which in turn will trigger new daily routines (e.g. swarming, finding hot spots, seeking out resources). Graphically (figure 1) the layers can be transformed into a compass.

In summary: The report tries to make predictions about the relationship between technologies and the evolution of specific daily life practices and behavioural patterns of households. Theoretically, the compass can be extended and it can be used in order to examine different technological developments in greater detail or to understand better the specific meanings of practices in various cultures, regions and countries.

The Household of the Future: the Forecast

Overall it can be assumed that the changes we are about to observe will lead to a new household paradigm that will radically alter the concept of domesticated societies as we know them. According to a path-breaking study by Peter J. Wilson domesticated societies emerged when hunters/gatherers started to live in stable settlements and created boundaries between the public and the private spheres. This notion of boundaries determined the behaviour and shaped the life of individuals and communities. New technologies, notably new sensor technologies, will transform or even do away with these boundaries. They will lead to new daily routines and practices and thus recreate the way how we will deal with the distinction between private and public spheres. Three dimensions are important in this respect:

- First, privacy will less be linked to (physical) boundaries or places. The **public sphere will become privatized** and individualized, so to speak, because focal points and information hot spots will convey personal messages and create an environment that changes according to personal needs and desires. Both the private and the public sphere will experience a proliferation.
- Second, until now we access the virtual space through our computers. What we see on the screens is a reflection of the objects we want to interact with. However, new technologies will enable us to interact directly with these physical objects and surroundings. In consequence, we will observe a shift from accessing the virtual space towards **interaction with social objects**. The physical environment will be transformed into social objects that adapt and correspond to our demands.
- Finally, so far interactions are successive and episodic; interactions are a series of discrete events. The episodic nature of interaction will disappear and be replaced by continuity and permanence. We will move towards a world of **"always-on-awareness"**.

In an exemplary way the report explores corresponding changes in household patterns and behaviour, makes forecasts about business opportunities, and provides hints for developing company strategies in four areas: information work, social networking, mobile life and identity creation.

Information Work

Living in an "information age", as we do, requires specific skills. Filtering and screening the information (over)flow already is a major task in everyday life. According to the report, this task will have been reshaped and received a new quality by the year 2012. Three major changes are identified in the report: First, we will move away from filtering information that is sent to us. Instead information will be embedded in the environment, i.e. in physical objects. Hence, we will have to find these objects in order to receive the information that is for our personal use. Second, we will increasingly interact with social objects whose information is based on contexts and individual needs. E.g. clothes, GPS etc. will carry information that will adapt to the environment (e.g. cosmetics adjust to your skin needs or the day light). Finally, until now scheduling and planning events is based on episodic coordination of our activities. We continuously update and coordinate our plans and make permanent rearrangements. The householders of the future will be able to connect various information flows and thus coordinate their activities on a permanent basis. Hence, they will live in a persistent world.

It goes without saying that these technology driven developments will trigger behavioural changes. Individuals will have to learn how to manage and author their information flows; they will have to learn how to identify and use information hot spots that are embedded in their physical surroundings; and they will have to learn how to deposit information at focal points. Accordingly businesses should strive to readjust their strategies. They have to explore new ways in order to offer goods and services to consumers by finding possible information landscapes and by ways of linking information with objects.

Social Networking

Like information work social networking will also be altered through the emergence of focal points, social objects, and persistent worlds. I&C technologies already have affected the structure of social networking. Due to cell phones, e-mails etc. our social networks have become geographically expanded as well as socially and culturally more diverse. Sensors, wireless communication and mobile computing will add new dimensions to social networking. The report predicts that we will, first, move toward swarming, i.e. a practice by which a social network is created and maintained for a specific purpose (e.g. congregating a consumer group to profit from a discount). Second, the existence of social objects will lead to partnerships with machines. As we will be able to interact with machines we can offload work to them and let them make decisions for clearly defined tasks. Third, so far social networking is based on episodic contacts and intercourse. However, persistent worlds are based on continuity and permanence. Messages that go on for an indeterminate period of time can create a sense of presence, of "being" at a place, that one has left already. This sense of presence may be created and sustained by sounds, images or even scents that will be part of communication.

Behaviourally the members of a household have to learn how to manage this new type of social networking. They also have to determine the degrees as to which they want to have machines make decisions - e.g. under which circumstances the vacuum cleaner turn itself on or off. At the same time they have to make sure that the possibility of continuous presence will not lead to social overexposure. Privacy and intimacy have to remain possible and guaranteed.

Mobile Life

Mobility already has become an integral part of our daily routines and practices. Many do personal or professional work while they commute. According to the report, the move toward technologies that highlight focal points, social objects and persistence will redefine the nature of mobility once more. Focal points will add flexibility to boundaries. As we will be able to transport focal points we will transform boundaries into center-periphery relationships. Relationships and activities will, hence, not be determined by in/out distinctions but by the relative position to the center and the periphery. In addition, we will stop carrying resources with us - like computers, cell phones etc., but rather look for them out in the surroundings. In consequence, the upcoming type of mobility will – in a way – resemble traditional nomadic practices of carefully scrutinizing the environments for signs of resources, opportunities, and threats. Finally, until now mobility is understood as a transition zone that connects places. In the future mobility will be transformed into a contextual presence. Persistent worlds will allow us to maintain presence even while we are on the go. Again these shifts demand new consumer skills and desires.

Creation of Identity

Technologies can affect the creation of identity in two ways: On the one hand, technologies very often are to symbolize a specific status or attitude. A certain technology might be used to set you apart from others. On the other hand, technologies are means for expression; they are media that enable us to represent our selves.

As far as identity creation is concerned we rely on context switching, i.e. we switch our identity as soon as we enter a new social context. We switch from one role to another (e.g. from business man to friend to family member etc.). The report forecasts that social networks will become far more complex and differentiated. Under those circumstances, switching social networks and our identities might create stress. Yet, focal points conveying messages adapted to the environment can reduce the stress provoked by switching contexts because the context reacts to your needs and desires. Furthermore, you might use social objects as conveyer of your identity. This kind of "digital tattooing", as it is called in the report, allows you to put aspects of your identity into the physical world or to create a "chameleon body" - like cosmetics that adjust to temperature or light. Finally, the idea of being part of a persistent world will allow you to remain present in a surrounding even if you are physically gone. For example, you might implant your voice into your children's most favourite bedtime book, and each time your child opens the book it hears your voice.

Towards a New Nomadic Daily Life?

Overall, householders will have to reorient their lives around new focal points, they will develop relationships with social objects, and they will have to live up to the task of managing presence in a persistent world. Hence, a new household paradigm will emerge that may move towards a new nomadic life.

In principle, the framework can easily be applied to various domains. The layers of the framework can be adjusted or, if need be, extended in order to accommodate varying expectations and environments. Different core issues can, thus, be placed in the centre or new domains or regional and cultural differences can be added.

Originally the report was neither addressed to policy-makers nor was it intended to be used for public policy-making. Its main purpose was to forecast demands and needs of household and consumers in order to enable businesses to explore new markets and develop innovative products. It is this goal that can perfectly well be pursued with the framework. Businesses can adjust the framework to their needs and market profiles. Notably the combination of technological developments, household domains, and behavioural changes will enable companies to adjust their market strategies. Yet, due to its flexibility it could well be imagined to use the compass for policy-making, too. Policies that deal with the household of the future can be based on respective forecasts and thus better address upcoming changes.

Sources and References

http://www.iftf.org/docs/sr-788_a_thehouseholdhorizon.pdf
http://www.iftf.org
Peter J. Wilson, *The Domestication of the Human Species,* Yale University Press 1991.
Institute for the Future, *Social Networks in a Word of Abundant Connectivity*, SR 764.

Knowledge Society in Germany 2015

Authors:	Werner Reutter/ werner.reutter@rz.hu-berlin.de		
Sponsors:	European Foundation for the Improvement of Living and Working Conditions; Dublin, postmaster@eurofound.eu.int		
Type:	National foresight exercise, all S&T		
Organizer:	PREST (University of Manchester, coordinator), Empirica (Germany), Futures Research Center (Finland), and ATLANTIS (Greece)		
Duration:	2001-2004	Budget: N.A.	Time Horizon: 2015

Purpose

The EUFORIA foresight project on Germany is part of the European four-year work programme: Analysing and Anticipating Change to Support Socio-Economic Progress 2001-2004. In the framework of this programme the European Foundation for the Improvement of Living and Working Conditions launched a project on the impacts of the European Knowledge Society on living conditions, working conditions, and industrial relations. The report describes the present situation in Germany, provides different scenarios of the Knowledge Society in this country, and addresses policy implications accruing from the findings.

Closing the Gap between Lisbon Agenda and Technological Progress

The foresight project EUFORIA is a child of European integration. The European Foundation for the Improvement of Living and Working Conditions has been EUFORIA's midwife. In the context of its four-year programme the Foundation has launched a foresight project – EUFORIA – on the "European Knowledge Society and its influence on living conditions, working conditions and industrial relations." At the same time the project was inspired by the Lisbon Objectives, EUFORIA's godfather. The Lisbon Objectives of the year 2000 laid out that the EU was to become "the most competitive and dynamic knowledge-based economy, capable of sustained economic growth with more and better jobs and greater social cohesion." EUFORIA was supposed to help identify how social foresight might fill the gap between forecasts on technological developments and the Lisbon Council employment strategy. Furthermore, the foresight concept of EUFORIA is closely linked to the Commission's Sixth European Research Programme 2002-2006 concerning network-building and the innovation policy framework of the European Research Area.

Accordingly, EUFORIA has analytical, forward-looking, and policy-oriented objectives:

- First and foremost it is to increase our understanding of the forces – called "drivers" – that shape the evolution of a Knowledge Society in Europe.
- In addition, it is to anticipate potential impacts of the Knowledge Society on living and working conditions and industrial relations.
- Finally it is to explore the best paths toward positive transformation while avoiding unsatisfactory developments. Hence, it includes policy aspects.

In the year 2002 the project has entered its second phase in which a report on advancement indicators was to be developed, national foresight centres were to be set up, and national foresight reports as well as a synthesis report were to be produced. Apart from the report on Germany, there are reports on the Knowledge Society in Finland, Greece, and Ireland and also studies on the European Knowledge Society.

EUFORIA: An Open-ended Approach

The way EUFORIA came into being as well as the objectives pre-determined the nature and the unique character of this project. Three features set EUFORIA apart from other forecast projects: its open-endedness, its encompassing nature, and the use of a mix of methods. EUFORIA is open-ended because it does not provide a forecast in a traditional sense. The goal is not to predict a specific future but rather to identify possible paths toward a Knowledge Society. EUFORIA attempts, hence, to identify factors that shape and form possible futures. The project is encompassing because it takes technological issues as well as the working and living conditions and industrial relations into account. In the framework of the project a mix of methods has been applied. Foresight methods were combined with socio-cultural, socio-political, and socio-economic reasons. In total, 10 (soft and hard) foresight methods - including: Delphi, SWOT, STEEP, brainstorming - were used. Overall, the approach was characterized as: **integrative** - involving experts, policy-makers etc. from 25 countries, **explorative** - because 10 different foresight methods were applied, **experimental** - new methods were developed like the Critical Influence Analysis, **developmental** - findings from one method were used as inputs in later stages thus creating a sort of dynamic learning curve and f**orward-looking** - the time horizon was set at 2015.

Empirica that set up a National German Knowledge Society Centre and organized two workshops involving 23 experts prepared the German report. In order to analyze the current situation, identify the "drivers" toward a Knowledge Society (KS) in Germany, and forecast possible scenarios official and public data as well as other indices were used. In addition, the Delphi-method and EUFORIA KS-indicators contributed to describe strengths, weaknesses, opportunities, and threats (SWOT) of the KS in Germany.

Current German Situation: 'Sleeping Giant' or 'False Giant'

Like other foresight projects EUFORIA had to deal with the problem that we tend to think in linear terms. We analyze a situation, identify forces that will change the situation and then predict the future. Even though the foresight project partly proceeded in the same manner it deliberately took into account that respective developments are highly contingent and include forces that influence each other. In consequence, the report not only provides an analysis of current national circumstances - living conditions, working conditions, industrial relations - as well as on the German Knowledge society, but it also identifies forces that might drive Germany towards a Knowledge Society. In addition, the approach embraced the idea that the future can shaped through politics.

It is difficult to tell whether Germany is on its way towards a Knowledge Society. Actually, Germany gives conflicting impressions: On the one hand, it can be regarded as a sleeping giant. The country remains well under its possibilities and potentials. Yet, if awakened the giant could easily catch up to the leading Knowledge Societies in Europe. On the other hand, Germany can be compared to "Tur-Tur", a figure from a former popular TV child series. "Tur-Tur" was a false giant. Even though he looked gigantic, even frightening, from afar, he became small, even tiny to those who dared approaching him. Based on the current situation Germany can be: a sleeping giant or "Tur-Tur". The analyses of the national circumstances and the Knowledge Society offer enough proof for both images.

National circumstances include living conditions, working conditions and industrial relations. As far as these dimensions are concerned the situation in Germany is well known. Like other European countries, Germany has to deal with **demographic development**s - ageing society, **changing family patterns** - e.g. increase in single households, severe **economic problems** - e.g. low economic growth, high unemployment, low female unemployment, rising saving ratios etc. and rather **low flexibility of work forms**. At the same time, trade unions have experienced a decline as far as membership, influence and acceptance were concerned. This is even more problematic as trade unions are institutions that can help to make working conditions socially acceptable.

Knowledge Society in Germany: Based on indices, ratings, and studies from e.g. IDC, World Economic Forum, UNDP and others Germany is doing fairly well as a Knowledge Society, but by far not excellent. The country seems to catch up with the best though, but no study shows Germany as a frontrunner in this domain. The analysis provided by the EUFORIA project mostly confirms these findings. As a Knowledge Society Germany is just average. But a more detailed analysis shows that Germany does have the potential to catch up with more advanced countries like Finland. The country profile (figure 1) brings this potential to the fore. The figure provides an overview of the current situation in Germany along 29 relevant KS-related indicators. The EU average was set at 100. Germany performed better - meaning that e.g. infant mortality in Germany is lower than in other EU countries - in those dimensions where the country exceeds EU average.

Based on these findings the strengths, weaknesses, opportunities, and threats (SWOT) can be analyzed. According to a SWOT analysis the German Knowledge Society does show some **strengths** - innovation ability, willingness to self-directed training, appreciation of flexible work forms, broadband access - and provides **opportunities** - strong shift toward service industry, little income disparities, high degree of quality of life. However, there are also important **weaknesses** - poorly educated new generation of workers, rising unemployment, gap between electronic media and education - and significant **threats** - poorly educated generation of workers, negative effects of high unemployment on the economy, which in turn threatens R&D activities. Germany has to address the basic question, whether the country will be able to profit from its potential, in spite of the fact that many KS-related indicators are just at average EU-level.

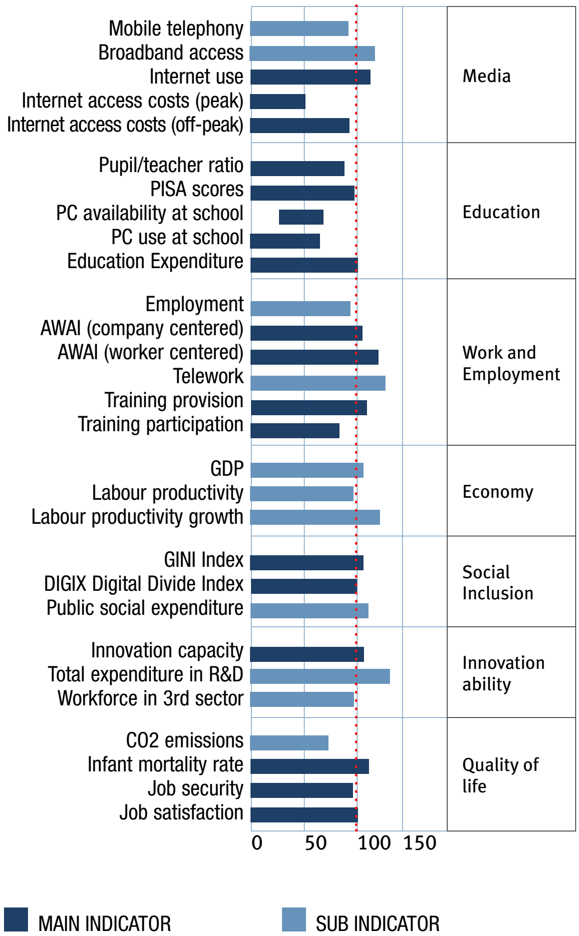


Figure 1: Knowledge Society country profile Germany:

AWAI = Adaptability of Work Arrangements Index

Gini index is a measure of inequality of a distribution

Drivers of the Knowledge Society in Germany: Biased Indicators?

In order to forecast future developments it is necessary to identify those factors that shaped the current Knowledge Society in Germany. EUFORIA attempted to specify these "drivers" through workshop discussions with experts. During two workshops the experts came up with 18 factors that were thought to have had at least some impact on past developments. The factors cover various areas. Some factors address **living conditions** - like ageing society, immigration, problems in education, others **labour market issues** - e.g. "culture of dependency", exaggerated certificate culture, others **economic structures** - e.g. strength in traditional industries, others **political issues** - e.g. society of compromise, permanent political blockade, cost of reunification and some just took the size of the country as a disadvantage. On the whole the list of these factors not only looks a bit arbitrary, but it also gives the impression that the experts thought of weaknesses and threats rather than of strengths and opportunities. In fact, it is difficult to see which of the factors mentioned in the report actually contributed to the existence of a Knowledge Society in Germany.

The experts also tried to evaluate the impact of a future national trend towards a Knowledge Society. For this exercise the Metaplan technology was used. It produced differentiated and context dependent results in various areas. The report has grouped the effects discussed in the workshops under six headings: economy, technology, social issues, politics, environment, and values. Overall the exercise identified 32 impacts that will be affected by the trend toward a Knowledge Society. For each area the experts could rate the importance of the impacts; they had to assign values ranging from -3 to +3, which allowed determining the relevance of each factor. For example in the domain of the economy the most important impact was accredited to "networking and outsourcing" - it received 9 points. It was assumed that telework would become more widespread, that organisations will outsource tasks, which in turn will foster and accelerate the development of global networking. The highest rating (29 points) received the factor: "Organisational set-up and culture, which recognises the human being and puts them at the central focus" - social issues. Overall this was an attempt to combine analytical approaches with the Delphi method.

Scenarios for the Future German Knowledge Society

As a result the EUFORIA team developed a series of scenarios about the future of the Knowledge Society in Germany. The scenarios had the same structure and were based on some common elements - demography, I&C technologies, global economic growth, European cohesion, security, social issues, labour market and education.

The EUFORIA team at Empirica developed three scenarios:

- CRASH: "Crash into the second league",
- STAGNATION: "Business as usual",
- CHANGE: "From average to excellence".

In order to determine policy strategies and the roles of key players it was necessary to pick one of the scenarios as the most desirable one. It goes without saying that the experts selected "CHANGE" unanimously as the scenario Germany should strive to achieve. In this scenario the problems mentioned above will mostly have disappeared. Just to mention a few of the many examples that are given in the report:

- The government will have managed to overcome institutional inertia and successfully embarked on structural reforms.
- There will be sustainable economic growth between 1.5 and 2.5 per cent and a balanced federal budget.
- Unemployment will has significantly been reduced and the

social security system has undergone structural reforms.
- Similar positive developments will have taken place in other areas.

Based on the scenario CHANGE the experts made a number of policy recommendations. In a nutshell Germany is to continue and expand its so far cautious reform steps. The government should implement e.g. Agenda 2010 and the finance and tax reform. Whether these reforms can best be realized by a new Alliance for Jobs or not, remained an open question. Yet it was agreed that the reforms undertaken so far can only be seen as a very first step in the right direction. In addition, trade unions as well as other key players will have to redefine their roles.

German Policy-makers – Resistant to EUFORIA Advice?

The EUFORIA project is an ambitious and challenging foresight enterprise. It offers new and innovative approaches and new methods for the difficult task of forecasting the future. Especially the attempt to enlarge the perspective beyond mere technical developments and include social and working conditions as well as industrial relations has to be regarded as exemplary for similar enterprises. In addition, the idea that politics will have an important say for future developments is highly instructive. It argues against the widespread opinion that the future will be exclusively determined by technical and/or economic factors.

EUFORIA has moved foresight projects on a new methodological level. The combination of analytical and foresight methods, and the use of a mix of methods have produced interesting and promising results. In consequence, the approach has already triggered a reorientation in respective research and has been applied, e.g. in various PhD projects. It should be pointed out though that for some parts of the report a more structured and analytical approach would probably have produced better results. In addition, the method applied in the project is resource intensive.

Even though the project also includes policy recommendations, it is not clear from the report whether EUFORIA had any impact on political decisions in Germany so far. According to other reports this was different in other countries as well as in the EU where EUFORIA had a significant impact on decision-makers. And it is likely that at a later stage of the project EUFORIA might also become a major source for political decision-makers in Germany.

Sources and References

The Knowledge Society in Germany: Current situation and future trends, Dublin 2004.

Rural Ireland 2025

Author	J. Kinsella, P. Commins, B. Riordan, J. A. Walsh, D. Meredith, E. Pitts, O. T. Carton, H. Tunney, J. Finn, L. Downey, J. Fennessy, L. Mac Lennan and P. Crehan for the EMF (comments to Patrick.Crehan@cka.be)
Sponsors:	The Department of Agriculture and Food The National Council for Forest Research and Development - COFORD The Environmental Protection Agency The Marine Institute
Type:	A Single Issue National Foresight Exercise
Organizer:	The National Institute for Regional and Spatial Analysis or NIRS at NUI Maynooth The Department of Agribusiness, Extension and Rural Development at University College Dublin The Rural Economy Research Center and the Environmental Research Centre at Teagasc
Duration:	2003-2005 — Budget: € 100 000 (approx) — Time Horizon: 2025

Motivation

Ireland has set ambitious goals for the development of its rural regions. This foresight exercise asks if the goals of state policy for rural Ireland will be achieved on the basis of current trends, what can realistically be achieved and what needs to be done to ensure a desirable outcome. The conclusions of this foresight exercise are framed in terms of 3 main actions to be undertaken immediately if the state is to realise its ambitions.

Are We on the Right Track?

Irish government policy for rural areas aims to build a rural economy characterized by:

- Commercially competitive enterprise that does not damage the environment,
- Vibrant sustainable rural communities,
- A quality of life that makes rural areas attractive places to live and work,
- Equity of opportunity for citizens of all ages living in rural and urban areas, and
- Balanced development between the regions.

Despite general acceptance of these ambitions, there was a growing sense of unease among experts and managers that if current trends continue Ireland will fail to deliver on these goals. In particular there was feeling that the impressive economic growth of the 1990s masked underlying weaknesses.

Past growth depended heavily on foreign direct investment, but evidence already suggested that manufacturing may move abroad in search of lower costs and for greater proximity to new and emerging markets. It was felt that growth in exports from strong indigenous companies would remain relatively low. Many threats to rural economies were identified that would need to be addressed immediately:

- The number employed in commercial farming would be dramatically reduced,
- Developments in the broader rural economy would not offset the losses that this would incur,
- New types of employment would not benefit those outside commuting catchments zones,
- The full potential of the natural environment in terms of competitive farming and forestry, the exploitation of public goods such as valuable landscapes and carbon sequestration, as well as the exploitation of the marine resources would not deliver on its full potential,
- Rural areas would lag urban areas in terms of infrastructure,
- Development would be lob-sided and would concentrate in a limited number of areas of the country.

FDI clients are strongly oriented towards manufacturing and are situated at relatively low points in the value chain. The contribution of services to national GDP exceeds 70% in some countries but accounts for only 55% in Ireland.

Between 2001 and 2004 there was a net outflow from Ireland of 15,000 jobs in these sectors. In tourism visitor satisfaction rates are declining in terms of perception of value for money and quality of infrastructure. Business expenditure on R+D is concentrated in large foreign owned companies. The majority of SMEs have a low capacity for technology absorption. Public funded research tends to be concentrated in the universities. This tends to be basic or academic in nature and strategic research linked to product or process innovation, research on new technologies, marketing or supply chain management tends to be neglected.

The spatial differences in farming and land-use are increasing and growth is unbalanced. In the 1990s growth in Dublin and the 3 neighboring counties average 13.7% whereas that in rural areas remain at 9.5%.

For these reasons a foresight exercise was launched in 2003 to:

- Provide long-term perspective on the rural economy in Ireland,
- Explore possible new forms of employment and
- Develop visions of a transformed agricultural sector embedded in a more knowledge intensive rural economy.

Overall Structure of the Exercise

The work was organised and overseen by an **Inter-Institutional Working** Group involving experts from Teagasc, the NUI and UCD.

Outside expertise was provided by a **Foresight Consultative Forum.** This included international as well as national expertise from banking, industry, public administration and academia.

A rigorous basis for discussion was provided by a series of **thematic papers** on the following topics:

- Economic Conditions in the 2025 Baseline Scenario,
- The Broader Rural Economy,
- Some Spatial Dimensions: Populations and Settlement Patterns,
- Foresight Study of the Agro-Food Sector,
- Foresight report on the Forestry Sector in Ireland,
- The Rural Environment.

These papers were developed by recognized experts who were required to address at least four main issues for each theme:

- Drivers of Change.
- Challenges.
- A Vision for 2025.
- Initiatives for a Better Future.

Meetings were held to discuss the papers and to develop a synthetic view of Ireland's rural economy in 2025 that would balance complex competing issues evoked in the thematic papers and raised in discussion. Finally a synthetic paper was developed that provided both sectoral and spatial baseline perspectives for 2025 as well as a discussion on:

- Strategic Challenges and Initiatives.
- Competitive and Sustainable Rural Economy to 2025.
- Knowledge Rural Economy.

This concluded with the formulation of a small number of clear recommendations representing the consensus view of the Inter-Institutional Working Group, backed up by strong argumentation and rigorous debate.

The Main Findings

The development of the rural regions and sub-regions is driven mainly by development in the major urban centers and their development is linked to their positioning in the global economy. The drivers of change in the rural economy are:

- Restructuring in the agro-food sector, mainly as a result of downward pressure on prices and incomes, a need to increase scale of production and processing, replacement of labour with capital, an increasing reliance on non-farm sources of income and concentration of farming in geographical optimal.
- Restructuring in the broader rural economy, due to the decline of income from primary production and growth in the service sector.
- Globalisation, striving for competitiveness, and the growing importance of innovation and the knowledge economy.

Important trends include:

- An outflow of labour from farming mainly due to fewer people entering it as a career accompanied by an increase in urban generated rural-employment.
- Realignment of land-use, regional concentration of tourism activity and declining social capital.
- Rising costs of doing business linked to the overall rise in cost of living in Ireland – higher rents, higher costs for food, insurance, energy and utilities.
- Heavy reliance on FDI for development as well as low levels of investment in R&D and innovation.
- Physical infrastructural deficits for access and transport, as well as weak knowledge infrastructure in rural regions – lack of knowledge clusters, third level and RTD institutions linked to global knowledge networks and available pools of expertise.

An extrapolation of current trends reveals a decline of the 'tiger' economy accompanied by:

- Elimination of agricultural subsidies and inadequacy of EU policies due to a failure to move towards a true CAP reform that addresses the needs of the broader rural economy will increase pressure on farm incomes.
- Inadequacy of institutions to address needed reforms and provide required knowledge based services for rural development
- Erosion of the manufacturing base, a failure of indigenous entrepreneurship and enterprise as well as the stagnation of rural tourism.
- Failure to maintain necessary infrastructure, failure to support social development in terms of amenities and services necessary for a high quality of life in rural areas, as well as rural migration and a demographic imbalance.

The Spatial Dimension

Analysis of the spatial development of Ireland reveals:

- Spatial differentiation of the farm economy between a prosperous east or south and a less prosperous north and west as a result of price pressure and towards areas of more productive land.
- Changes in land use due to competition for spaces for rural living to support commuter lifestyles, less intensive farming methods and conservation practices.

As a result it is expected that:

- The process of urbanization and spatial concentration of population and economic activity will favor Dublin and certain urban centers such as the NSS gateways.
- Rural economic and social viability will depend on the quality of linkages to a limited to major urban centers or on the ability of the region to provide an attractive living environment with a high quality of life.
- Commercial agriculture will further contract to be replaced by marginal and part-time farming and forestry even in areas where farming is traditionally strong.
- Clusters of companies will develop in high value-added sectors such as food and pharmaceuticals, medical technologies, software and international traded services.
- Some regions will continue their decline due to weak infrastructure coupled to a dependence on low-margin farming and 'old economy' enterprise.

The Agro-Food Sector

National forces include changes in agricultural policy as well as the impact of full employment due to the tiger economy. Key trends include:

- Farm labour forces are declining.
- The scale of viable commercial farms has increased.
- Farmers and their families increasingly depend for incomes from non-farm activities.

Various studies of the dairy sector indicate that Ireland has one of the lowest levels of productivity in Europe, a high level of competitiveness when measured in terms of cash cost of output, but a low level of competitiveness when alternative uses of land were taken in to account. Even the best farmers are leaving the sector due to low return on investment and the decreasing role of agriculture in the economy as a whole. Secondary processing is less and less dependent on local production and growth has been accompanied by increasing purchase of food commodities from the global marketplace. Furthermore it relies increasingly on imported labour. Many secondary processing companies may find it advantageous to relocate to locations with easier access to markets or cheaper labour – for example to new member states.

The Forestry Sector

Forestry has an impact on agricultural land-use, landscapes, habitats and bio-diversity. Forestry provides a carbon sink, an environment for recreation and a source of raw materials for energy and other industries. Planning cycles are long, being of the order of 40 years and government policy is to increase the area of forested land to reach a critical level of 17% of the total land area by 2030, by which time it will have achieved sufficient economies of scale to support be a world class, globally competitive processing sector. Drivers and issues were identified that ranged from the structure of incentives for the development of new forests, competition from the state as a provider of forestry products, 'extensive' farm management systems, the ability to charge for the provision of public goods, integrated land planning at national and regional level, as well as initaives to promote home–grown timber use and added value processing such as engineered wood products.

The Preferred Perspective for 2025

Current growth rates of 3-5% will be maintained on the basis of a sectoral business mix that is able to:

- Maintain and develop key export oriented sectors.
- Reinforce niche sectors where Ireland has a sustainable competitive advantage.
- Develop new opportunities in internationally traded services.
- Upgrade old economy enterprise and offset company closures with start-up creation.

This will rely on:

- An improved institutional framework that recognizes regional development issues with better coordination and integration with national development policy. The continuation of national development planning practices established in relation to EU structural funds.
- A shift in emphasis from structural funds to regional cohesion funds aimed at strengthening regional competitiveness. A move away from the CAP approach to rural development with better integration of the rural dimension in a national spatial strategy. The implementation of county development strategies along with the ring-fencing of public investment funds for regional development.
- More explicit treatment of the rural and regional dimension of tourism in national tourism policy.
- The development of regionally based research and innovation systems that foster the development of regional innovative clusters, support companies with weak absorptive capacities and help them avail of timely adapted services, possibly based on new models of extension and knowledge brokerage.

- The development of infrastructure for access, communication and quality of life, supported by a system of social progress accounting.

The preferred future for the Irish agro-food industry in 2025 is one where Ireland is a high value added supplier of differentiated branded dairy products, aimed at sophisticated premium or niche markets. They would require a high level of skills for management, production, logistics and marketing that are unlikely to be found in smaller firms and so new innovation related service will be required. Research oriented towards the needs of a supply-driven sector will need to develop a demand-driven orientation. Innovation will focus on areas of comparative advantage although the basis for such advantage may change quickly and dramatically. Ireland could have a strong position in food bio-technology and in high value added functional ingredients. The skill base for this will need to be developed in line with foreign direct investment, technology acquisition and market research.

The preferred perspective for the forestry sector in 2025 includes elements such as:

- A minimum of 1 million hectares of forested area,
- Full-time employment of up to 20 000 people,
- Many more using forestry to diversify farm incomes,
- As much as 15-20% of Irish energy derived from wood.
- Achieving these goals would require a rage of measures that include:
- Integrated land-use planning at all level,
- Reward for production of public goods,
- Adoption of modern forestry management practices driven by state of the art R+D, and
- Measures to encourage investment, as well as measures to support and develop RTD, extension, continuous professional development, training and education for forestry related professions and activities.

Final Recommendations

Given the overall trends in terms of demography, the economy and the global competitive environment, Ireland will not achieve its goals for rural regions on the basis of the current model for development and existing institutional structures. To achieve its goals it needs to:

- Complete the national spatial strategy with a series of successive regionally focused national plans.
- Develop entrepreneurial and management skills to support competitiveness of rural enterprise.
- Further develop the business, technological and innovation capacity of agro-food firms.

Sources and References

'Rural Ireland 2025: Foresight Perspectives' available from:

- The National Institute for Regional and Spatial Analysis or NIRS at NUI Maynooth.
- The Department of Agribusiness, Extension and Rural Development at University College Dublin.
- The Rural Economy Research Center and the Environmental Research Centre at Teagasc.

About the EFMN: Policy Professionals dealing with RTD, Innovation and Economic Development increasingly recognize a need to base decisions on broadly based participative processes of deliberation and consultation with stakeholders. One of the most important tools they apply is FORESIGHT. The EFMN or European Foresight Monitoring Network supports policy professionals by monitoring and analyzing Foresight activities in the European Union, its neighbours and the world. The EFMN helps those involved in policy development to stay up to date on current practice in Foresight. It helps them to tap into a network of know-how and experience on issues related to the day to day design, management and execution of Foresight and Foresight related processes.

Malta's Marine Sector 2020

Author	Lisa A. Pace, Malta Council for Science & Technology - MCST/ lisa.pace@mcst.org.mt
Sponsors:	EU DG Research STRATA Programme and the Government of Malta
Type:	A sectoral pilot foresight exercise addressing the current and potential economic contribution of the marine sector in Malta.
Organizer:	Malta Council for Science & Technology (MCST), Jennifer Cassingena Harper Jennifer.harper@mcst.org.mt International Ocean Institute-Malta Operational Centre, University of Malta, Aldo Drago aldo.drago@um.edu.mt
Duration:	January-October 2003 · Budget: € 50 000 · Time Horizon: 2020

Purpose

With Europe's move towards adopting a common integrated maritime policy, a strong need was felt in 2002 for Malta to explore ways of re-assessing its maritime sector in terms of enhancing the competitiveness of its maritime industry and exploiting the marine RTD base in niche areas that could offer strategic opportunities for growth. The Marine Foresight Pilot Exercise implemented in 2003, used specific tools and adapted foresight approaches to address these concerns taking into account the particular socio-political and economic contexts of the Maltese Islands. The foresight process and its outcomes (a vision for 2020) triggered a strategic national dialogue on the importance of the marine sector, which was instrumental in positioning the marine sector among the priority areas targeted for public research investments in the National Strategic Plan for Research and Innovation 2007-2010.

Exploring Windows of Opportunity for the Marine Sector

Located in the Central Mediterranean, Malta is traditionally a maritime nation with key activities centered around **marine-related services** - namely transportation, shipbuilding and repair, tourism and leisure, and **resource-extraction** including fisheries, aquaculture and potable water extraction. The maritime sector operates through targeted investments in these specific sub-sectors with limited competitiveness and potential for overall growth.

Research efforts focus on monitoring the quality of the coastal and marine environments, with little R&D investment in industrial applications. Moreover, a limited capacity, both in infrastructure and human capital, allows for growth in a restricted number of research areas.

Within this backdrop, foresight was seen as a useful tool to explore new ideas and opportunities for unleashing the economic potential of Malta's maritime sector and enhancing its competitiveness. The Marine Pilot Exercise built on previous experience and skills gained through using foresight in strategic planning for the future. It was one in a series of three pilot exercises implemented by the Malta Council for Science & Technology within the e-FORESEE project.

Foresight provided a systematic way of engaging established experts in the key maritime sectors and new players in emerging areas, in order to address the existing fragmentation of resources, and the necessary measures to put in place an integrated marine RTDI Strategy in support of policy formulation and provision of enhanced marine services. The strategic discussions that emerged amongst the experts and stakeholders served to inform policy makers on how best to cope with the new challenges and obligations arising from EU membership.

A Snapshot of the Marine Environment in Malta: Trends and Opportunities

The overall aim of the pilot exercise was that of projecting trends for the marine sector to become a prime contributor of the local economy in 2020 by exploring future opportunities and proposing feasible management and development strategies to underpin them.

Objectives - The Pilot Exercise adapted foresight approaches and methodologies in order to:

- Quantify the relevance of marine-related industries and services to the economy and look at emerging trends, socio-economic patterns and drivers influencing the marine sector.
- Take stock of marine research and development in Malta to obtain information on the nature and extent of R&D initiatives conducted within marine-related entities.

- Assess through the scenario method, how the various key marine areas could be redressed to meet future needs whilst ensuring sustainable exploitation of marine resources and identify niche areas that could sustain existing marine industries and stimulate their growth and competitiveness.
- Spark ideas for new public-private partnership collaborations and industry-academia links.

The above would serve to make a case with policy-makers for investments in a dedicated marine research and innovation strategy and implementing programme that would provide the necessary R&D and knowledge base to sustain growth of the sector. The exercise was techno-economic in nature, as it focused on industrial and R&D applications, though it did take into account the social and recreational value of the coast and sea.

Quantifying the Marine Sector's Contribution to the Local Economy

A launch seminar on **"Trends and related developments in the Marine Sector"** served to map the stakeholders in public and private marine-related entities and academia and to identify experts within the relevant ministries, local authorities, marine industry etc. with expertise in key sectors of the marine environment and who would form part of an Expert Panel. Through the workings of this Expert Panel, the pilot exercise was implemented in a number of stages:

- Snapshot assessment on R&D initiatives in the main marine-related sectors and available information sources (studies, previous assessments etc).
- Semi-quantitative econometric assay, using mainstream economic indicators, on the contribution of marine-related activities to the economy.
- Horizon scanning exercise to identify emerging trends.
- Drivers influencing the marine sector.
- Normative scenario development (optimistic, intermediate and pessimistic).
- Dialogue and Dissemination: web-based forums amongst panel members and consultation with an extended pool of stakeholders e.g. from NGOs and the general public.

Although the foresight pilot sought primarily to engage expert opinion, participation of non-experts and the public occurred mainly through a virtual dialogue and dedicated events.

Strategic Viewpoints for the Future of the Marine Sector 2020

The econometric exercise carried out in the first phase revealed that the marine sector is already an important contributor to the economy with a share of 14% of the total GDP.

The Vision for the Marine Sector that emerged from the foresight exercise identified opportunities for new and diversified research ventures, with investments channelled towards innovative marine technologies and knowledge management systems for the provision of enhanced services. In this sense, the holistic as opposed to sectoral approach to development of the marine sector, could be used as a model for other areas of economic activity in Malta.

The Vision describes Malta as taking the lead in technological development and commercial applications in select niche areas of marine-related activities in:

- **Fisheries:** improved surveillance of fishing activities through Vessel Monitoring systems, promoting the Maltese catch as an "eco-labeled" niche market and promoting artisan methods for catching fish.
- **Aquaculture:** new and diversified cultured species e.g. non-fish marine organisms including seaweed; offshore farming; poly-culture ; closed re-circulation systems.
- **Marine Biotechnology:** exploitation of new biomaterials from indigenous species; targeting value added and modified fish food.
- **Marine observations, monitoring and forecasting:** improved marine observing and forecasting systems to describe the physical and ecological status of the sea as a precursor to control the health of the sea as well as to provide added-value products and services relying on routine marine data; accurate sea state nowcast/ forecasts, sea traffic control systems to provide an integrated data network for policy-makers.
- **Marine Energy and Resources:** exploiting available technologies for alternative energies e.g. offshore wind farming; exploring the potential for national RTDI contributions in environmental technology developments aimed at harnessing resources, including technology applications for cost-effective resource extraction, reduction of environmental impacts etc.
- **Marine Transportation:** making better use of marine space such as for short seas route transportation across the islands and development of high technology cargo transfer systems and related services.

The pilot identified the main challenges ahead for achieving this vision. These relate to creating an enabling environment in which to develop and commercialise these technological applications, including making available an adequately skilled human resource base and infrastructural capacity, putting in place incentive schemes to attract local and foreign investments in start-up R&D companies and providing the adequate policy framework to support this. Stronger public-private partnerships and industry-academia links must be set up in order to secure strategic marine R&D competencies.

One of the key recommendations emerging from the foresight process was that of establishing a dedicated Marine RTDI strategy and implementing programme in order to achieve the Vision and meet the above challenges. Due to its limited resources, Malta cannot aspire to develop a fully comprehensive indigenous marine research capacity; on the other hand it can be seen to play a vital role in disseminating European research excellence in the region and exploiting a brokerage role with other Mediterranean countries for regional initiatives in marine research, capacity building and environmental management.

Breaking Down Sectoral Barriers through Stakeholder Engagement

The Pilot exercise was effective in engaging stakeholders from different expert domains including different scientific disciplines, public decision-making bodies - the Maritime Authority, the Environment Authority, the Fisheries Control Division etc. and the private sector. The interdisciplinary Expert Panel that was set up thus tackled the marine environment from all its aspects other than taking a sectoral approach as often happens in this sense it provided a balance between the drive for economic and industrial development of the marine sector and conservation and preservation of environmental quality.

The exercise was successful in bringing on board actors from new areas of economic activity that would otherwise not have been involved in a dialogue on the marine environment such as Malta Enterprise, a government agency responsible for supporting enterprise. This resulted in the setting up of an extended network of actors that spurred the necessary momentum for new links to be latched between industry and academia and the public sector and the fledgling marine enterprise.

The main motivation for participation in the exercise stemmed from the opportunity for the stakeholders to be brought closer to the policy-making process and influence policy outcomes. The exercise generated informal learning by experts to other domain experts on state-of-affairs in the various marine sectors and on trends and opportunities.

The exercise drew on MCST's experience in running two other pilot exercises in adapting an appropriate mix of foresight tools and approaches for the objectives of the exercise. Whilst the snapshot assessment and econometric study provided better data on maritime industrial and research activities, scenario analysis and vision building triggered a process of exploration of the future and stimulated new thinking and ideas.

Setting up a Strategic National Dialogue for the Marine Sector

The marine foresight exercise was the first of its kind to provide a dedicated space and appropriate, flexible tools to address in a holistic manner the future of the Marine Sector. Although it was implemented over a short time frame, the exercise served to establish an on-going national dialogue among experts in the marine domain and policy-makers that extended beyond the lifetime of the pilot.

The knowledge generated through the foresight dialogue served to inform other on-going strategic conversations and policy processes in the making. MCST together with the Marine Pilot Champion co-organized a consultation with the Science & Technology Community to analyse how scientific research and innovation could be geared towards Malta's Sustainable Development Strategy 2006-2016. The consultation brought on board many of the experts who were active in the marine foresight pilot and who provided their strategic input into the national discourse.

More recently in 2005, the MCST organized a series of thematic stakeholder consultation sessions, including one on the environment, as part of a priority setting exercise for channeling public funds for research. This exercise provided input for the drafting of the newly revised National Strategic Plan for Research & Innovation 2007-2010, which will be launched for public consultation later in 2006. The Strategy has seen the incorporation of the Marine Environment and Technological Applications together with ICTs, Energy and Health-Biotech as a priority sector for investing national funds.

Other related initiatives emerged drawing on the outputs of the pilot and the networking generated:

- The findings of the pilot provided an important input for participation in an FP6 ERA-NET Project entitled MarinERA aimed at coordinating the marine research programmes of the partner countries and analysing the possibility for joint calls for proposals in the Priority Areas.
- Government, through the Malta Council for Science & Technology and in collaboration with international partners is leading an initiative (2006) to set-up a Euro-Mediterranean Institute for Training and Innovation (EuroMedITI) that will develop and commercialise technologies that have special relevance to the Mediterranean, including water and environmental technologies.
- Drawing from the Marine Pilot recommendation to include technology in Marine Sciences Education, the University of Malta revised the curriculum of the undergraduate science degree course to include biotechnology studies and applications (including in the marine sphere) with a view to better prepare graduates to permeate into the industrial world.

Sources and References

Drago A. (2004) "Building the best future for the Marine Sector in the Maltese Islands – A Vision towards Enhancing the Marine Sector's Contribution to the Maltese Economy in 2020" Marine Foresight Pilot Final Document.

National Strategic Plan for Research and Innovation 2007-2010: Building and Sustaining the R&I Enabling Framework (2006). *Document to be published shortly by the Malta Council for Science & Technology for public consultation.*

Pace L. and Cassingena Harper J. (2005) "Benchmarking Malta's Foresight Experience" A Report submitted to the Forsociety ERA-NET Network.

Technology and Innovation in Romania 2015

Author	Tonia Damvakeraki, damvakeraki@atlantisresearch.gr, Effie Amanatidou/ amanatidou@atlantisresearch.gr		
Sponsors:	European Commission – STRATA Programme, Romanian Ministry of Education, Research and Youth, German Agency for Technical Cooperation		
Type:	Single issue exercise: Biotechnology		
Organizer:	ARC FUND, Zoya Damianova, arc@online.bg, CRIMM – Romanian Centre for Small and Medium Sized Enterprises, crimm@imm.ro		
Duration:	2003-2004	Budget: N.A.	Time Horizon: 2015

Purpose

In Romania, the variety of actors involved in foresight activities has determined a mixture of objectives and rationales. The implementation of a foresight pilot exercise in Romania was itself an objective in order to have 'process' benefits such as building foresight capacities, networking, developing a culture of democratic, social dialogue, etc. In addition, although substantiating better RTDI policies in order to increase economic competitiveness in the light of the Lisbon objective is a primary concern, the foresight pilot exercise in Romania was designed for identifying and addressing weaknesses regarding the communication between the relevant stakeholders.

Introduction of Foresight to the Candidate Countries

The FORETECH project was supported by the STRATA Programme of DG Research of the European Commission and was implemented by a consortium of seven partners (Applied Research and Communications Fund, Bulgaria - Coordinator Foundation, "Romanian Centre for Small and Medium-sized Enterprises", Romania, Foundation of Research and Technology - Hellas, Greece, School of Slavonic and East European Studies, University College London, UK, Policy Research in Engineering, Science and Technology, Victoria University of Manchester, UK, Technology Centre AS CR, the Czech Republic, Hungarian Technology Foresight Programme, National Committee for Technological Development).

The mission of the FORETECH project was:

- To introduce foresight activities in two candidate countries (Bulgaria and Romania) building upon the experience and know-how gained by projects and initiatives already supported by the European Commission and the STRATA (Strategic Analysis of Specific Political Issues) programme, and running two pilot foresight initiatives for two similar sectors / areas in both countries,
- To build up capacity and competence on foresight through transfer of experience and know-how from the consortium partners from the UK, Greece, Hungary and the Czech Republic,
- To contribute the pool of knowledge on foresight in Europe through performing a review and evaluation of the foresight exercises in the countries participating in the project,
- To elaborate recommendations for the European Commission Policy-makers at other governance levels for specific measures to support S&T policies in candidate countries.

Two sectors were originally set for the foresight initiative:

- Information and communication technologies.
- Agriculture, food and drinks industry and biotechnology.

In the frame of the FORETECH exercise, there was one pilot exercise in Romania. According to the initial philosophy of the FORETECH project, the sector to be addressed was **bio-technologies and agriculture**. The efforts of the management team were concentrated on the implementation of the biotech pilot, following the directions set by the members of the Steering Group. After several meetings of the experts' panel, the scope of the exercise was defined as **'biotechnology research on the food chain'.**

Linking R&D and Innovation Systems in the EU

The exercise was originally envisaged in the timeframe of the FORETECH project by the European Commission and the German Agency for Technical Cooperation and was intended to reach two sets of objectives. A first set of objectives deriving from the project refers to nation-wide processes; here the public administration was seen as the main beneficiary of the FORETECH project. A second set of objectives regarded con-tributions for improving the European RTDI and foresight policies and recommendations for support measures in the countries involved in the project - Romania, Bulgaria, Hungary and Czech Republic.

Another objective of the project was to create a network of countries collaborating in the field of foresight and to strengthen the links with other networks in the field of RTDI and foresight.

On behalf of the national sponsor - the Ministry of Education, Research and Youth - the exercise aimed at strengthening the links inside the innovation system and providing feedback for upgrading the national medium-term strategy for R&D in the field of biotech in the context of the integration in the Euro-pean Research Area.

Strategic Challenges in Biotechnology

Biotechnology is widely recognised to be the next wave of knowledge based economy, creating new opportunities for the society and the economy.

Biotechnology in Romania is under the responsibility of a broad range of policies and actors. There is lack of a shared vision and common objectives while there is total absence of effective coordination of these policies. For this reason, Ro-mania is addressing the challenges and opportunities for de-veloping biotechnology with slow pace.

The tenor of the foresight exercise was that the democratic society of Romania should offer the necessary safeguards and channels of dialogue to ensure that the development and application of biotechnology takes place respecting the fundamental values recognised by the EU and the Charter of Human Rights.

Romania, as a part of Europe is confronted with a major pol-icy decision: either to accept a passive and re-active role in terms of the development of biotechnology in the rest of Europe, or to develop pro-active policies to exploit them re-sponsibly and in consistency with the European values, ethics and standards.

Involvement of Relevant Stakeholders

The main tools and methods utilised for the implementation of the FORETECH exercise in Romania were:

- **Brainstorming** sessions for stakeholder mapping,
- **Nominations and co-nominations** for selecting members for the National Expert Panel and the Steering Group,
- **STEEPV** (Social, Technological, Economic, Environ-mental, Political and Value-Based factors) framework for establishing priorities,
- **SWOT** analysis,
- **Scenario** building, and
- **Open** discussions.

The process of involving relevant stakeholders in the foresight pilot exercise in Romania was initiated even before the exercise had started. One key actor was the public administration whose support letters have followed the request of the management team to collaborate in the implantation of the exercise in Romania. A strong point was that the efforts of the management team in Romania contributed to the launching of a full-scale national foresight programme, in several scientific and technological areas.

In order to address relevant stakeholders, the management team organised several brainstorming sessions, desk research and meetings in order to create an overall picture of the interested parties. This ‘stakeholder mapping’ facilitated the organisation of numerous meetings, identification of a pool of experts to be involved in the foresight pilot-exercises.

Regarding the involvement of public administration in the foresight exercise the management team has tried to suggest the role of ‘flag-carrier’ for the state administration. There were a number of serious reasons for making this effort:

- Employing the foresight toolbox contributes to the de-mocratisation of governance.
- Government is more aware of the fact that the knowledge and information is spread across the country and is more willing to take immediate action in the light of a large consensus stamp for a set of agreed practical measures.
- In Romania, similarly to other countries, it is difficult to raise money for organising a full-scale national foresight programme funded by industry. The state-financed research has more tradition in grounding sectoral strategies / policies. In the case of state support, the initiator is obviously the main beneficiary of the results and outcomes of such a programme.

Regarding the involvement of stakeholders, the awareness raising and consensus building events organised by the man-agement team was fruitful, but one must note the feeble in-volvement of industry, consumer groups and citizens in the foresight activities compared to the scientific community and the public administration; this resulted in a more top-down exercise, using a pool of experts coming mainly from the field of R&D. However, a strong characteristic of the exercise is the multitude face–to–face meetings with stakeholders.

Additionally, CRIMM Foundation’s initiative to organise two regional foresight pilots was accompanied by several meetings and telephone conversations with stakeholders, an awareness seminar in collaboration with the respective municipality and another consortium that was at the time implementing a project also financed by the National Plan for RTDI. Unfortunately, despite the visible interest in running these pilots locally, no sufficient funding was found for implementing this initiative.

However, a more bottom-up approach would have been desirable, especially in the regions, where the geographical distance between the actors is smaller and the distribution of relevant knowledge might be more concentrated, thus facilitating a more democratic exercise; anyway, the participation of citizens and smaller groups of interest is one of the most challenging tasks for a foresight exercise. The old disease of the national innovation system of former socialist countries is still at large in Romania: the weak links between research and business.

Biotechnology Applications: Solution to Major Problems

Biotechnology is regarded as one of the most promising frontier technologies of the future. It enables other technologies – e.g. information technologies – to be applied for a wide range of purposes. On the basis of scientific breakthroughs that have taken place in the recent years, the 'knowledge revolution' on new systems is set to deliver a continuous stream of new applications.

In the agro-food area, biotechnology has the potential to deliver improved food quality and environmental benefits through agronomical improved crops. In Romania, the cultivated area with genetically modified crops (GMs) recorded a significant increase during the last few years. Food and feed quality may be linked to disease prevention and reduced health risks. Plant genome analysis has already led to the genetic improvement of traditional European cereal crops with an increase in the protein yield, which may be used as an alternative source of protein for animal feed. Considerable reduction in pesticide use has also been recorded in crops with modified resistance which can lead to reduced use of chemical pesticides, fertilisers and drugs, and increase use of conservation tillage – hence promoting more sustainable agricultural practices, reducing soil erosion and improving environmental protection.

Romania could use biotechnology in order to improve the non-food uses of the crops. Biomass could contribute to alternative energy resources with both liquid and solid bio-fuels such as bio-diesel and bio-ethanol as well as processes such as bio-desulphurisation. Plant genomics also contribute to conventional improvements through the use of marker-assisted breeding, while biomass could also be used as a renewable resource for chemical industry.

Building Foresight Capacities in Romania

The most important outcomes of the exercise are the building of foresight capacities in Romania (Learning-by-doing) and the immense contribution to the launching of full-time scale foresight programme by the Romanian government. The Ministry of Education, Research and Youth through the National Plan for RTDI financed this programme.

The decentralised plan allows for autonomy and separate budget shares at the level of sectoral programmes that deal with specific scientific and technological areas.

Five out of nine projects are being implemented in fields related to biotechnology:

- Biotechnologies - BIOTECH Programme.
- Agriculture and Food - AGRAL Programme.
- Life and Health - VIASAN Programme.
- Environment, energy, resources - MENER Programme.
- Basic and socio-economic research - CERES Programme.

Besides these nine sectoral exercises, there is also another project for updating the strategy for technological restructuring in 10 industrial sectors, managed by the RELANSIN Programme from the National Plan for RTDI.This project also includes the use of foresight methods for its implementation. The average duration of these projects lies between 8 to 12 months, with an average budget of around € 30 000 per project. Furthermore, CRIMM Foundation in agreement with MERY and the Ministry of Public Administration and Internal Affairs will take actions for the organisation of training courses in foresight or – will at least – facilitate the participation of government officials to foresight related events organised abroad.

Key Issues Raised with Particular Relevance for Policy-making

The public debate on biotechnologies and the fundamental values affect the need for responsible and coherent policies to govern these fast moving technologies. All key stakeholders have stressed the importance of governance, i.e. attention to the way public authorities prepare, decide, implement and justify policies and actions taken.

Romania should apply the highest standards possible for governance of biotechnologies among the following 5 action lines:

- Societal dialogue and scrutiny should accompany and guide the development of biotechnologies.
- Biotechnology should be developed in a responsible way and always in harmony with ethical values and societal goals.
- Well informed decisions should facilitate demand driven applications.

- Science-based regulatory oversight should enhance public confidence.
- Basic regulatory principles and legal obligations should be respected to safeguard the integration of these technologies in the Romanian market in the frame of the Community single market and international obligations.

Public Participation in Biotech Matters

Taking into consideration the EU strategy for the development of biotechnology, the Romanian government has set the following priorities:

- In order to meet societal needs and increase its economic competitiveness, Romania should address many of the global challenges relating to health, food, environment, sustainable development by involving human, industrial and financial resources. It is necessary to develop policies accordingly.
- Public support is essential in order to address ethical and societal implications and concerns. Romania has to develop effective, credible and responsible policies that will be trusted and supported by its own people.
- It is crucial that Romania will identify the best possible means to respond to the challenges concerning scientific and technological revolution taking into consideration the international perspective.

Biotechnology has raised significant public attention and debate. Dialogue in this case should be inclusive, comprehensive, well informed and structured. Constructive dialogue requires mutual respect between the participants, innovative approaches and time availability. It should be structured in agreement with the stakeholders to allow progress, for example in the provision of better information and mutual understanding. Experience has also proven how important it is that dialogue takes place at the local and national levels, as well as internationally.

Dialogue should be open and inclusive for all stakeholders. Public authorities should facilitate and ensure the participation of stakeholder with limited resources. Economic operators, industry and users, who have economic interest in these technologies, as well as the scientific community, bear a particular responsibility for active participation.

Sources and References

http://foretech.online.bg/romania.php

Slavo Radosevic, foresight as S+T and Innovation policy tool: policy lessons from Bulgarian, Romanian, Czech and Hungarian foresight exercises, 2004.

South African Benchmark 2020

Author	Sylvie Rijkers-Defrasne, Future Technologies Division, VDI TZ/ rijkers@vdi.de		
Sponsors:	Department of Trade and Industry - DTI, http://www.dti.gov.za		
Type:	National foresight exercise		
Organizer:	Bluepeter Management Consulting, Access Market International (Pty) Ltd		
Duration:	N/A 2004	Budget: N.A.	Time Horizon: 2010-2020

Purpose

The overall goal of this foresight study is the identification of global technological trends, which will influence the competitiveness and future development of South African industries over the next 15 years. The study specifically focuses on innovation areas that hold the potential to reduce industrial dependency on foreign technology. Broad-based recommendations are formulated, intending to support the formulation of policies, strategies and programmes aimed at growing South Africa's technology and innovation base.

Foresight: A New Instrument for Supporting R&D Decision-making in Post-Apartheid South Africa

South Africa is one of the most economically developed countries in Africa and Africa's leader in R&D. Over the past decades, it has developed a vast technological base - mostly on an autarkic basis as a result of the country's isolation during the apartheid era. At that time, the R&D focused on the fields of energy, nuclear technology, mining and armaments industry. South Africa is today still among the world's leaders in the fields of mining, agronomy, medicine, in the production of synthetic fuels and in some branches of the armaments industry. After the transition to democracy in 1994, the former Department of Arts, Culture, Science and Technology (DACST) has initiated measures to reform and modernize South Africa's national innovation system and the science and technology policy has been reoriented.

The study "Towards a Science and Technology Policy for a Democratic South Africa" published in 1993 by the International Development Research Centre recommended the use of technology foresight methods to determine national research priorities. The fist national foresight study was initiated in 1998 by the DACST and focused on the following topics: Agriculture, Biodiversity, Crime Prevention, Energy, Environment, Financial Services, Health, ICT, Manufacturing, Mining and Metallurgy, Tourism and Youth.

The present benchmarking study is the second national foresight study in South Africa, initiated by the Innovation and Technology unit (I&T) of the Enterprises and Industry Development Division (EIDD) at the DTI. This unit provides technology support to industrial sectors with the overall purpose of enhancing industrial sector development.

Starting point of the present study is the insight that an in-depth understanding on global technological developments and the dissemination of such information is the key to long-term competitiveness of South Africa's industries in the global context. The study differs from the first national foresight study that pursued a broad socio-economic approach.

Macro and Micro Level Approaches Combined

The study aims at analysing technology trends, benchmarking technologies capable of driving the South African economy and benchmarking South African technology programmes with those provided in other countries. The study, at a macro level, focuses broadly on global technology and sectoral development as well as global technology and innovation promotion developments. The outcome of the macro-level global assessment informs a micro-level per country (or industry sector) assessment including several developed countries (USA, EU countries, Australia) and emerging or newly industrialized countries (Turkey, Malaysia, Brazil, China, India).

The following industry sectors are covered: ICT, tourism, chemicals, biotechnology, automotive industry, aerospace, metals and minerals, culture, clothing & textile, agro-processing.

For each sector, the study identifies global technology development trends, specific current and emerging technologies and the role of such technologies in sectoral development. Also the relative importance of such technologies in the South African industrial development landscape - market opportunities, implementation requirements, infrastructure, cross-cutting applications, enabling technologies, etc. - is assessed and specific recommendations for intervention are made based on a SWOT analysis. Furthermore, the study assesses current support offered by governments throughout the world for technology and sectoral promotion, and provides corresponding recommendations on strengthening the role of the South African government, and specifically the DTI in technology and sectoral development. The investigations based primarily on desk research but also included inputs from an international network of associates (per country investigations) and interviews with stakeholders and experts.

Strategic Technologies Identified for the South African Industry Sectors

ICT

The following global technology trends were identified:

- **Mobile technologies** - wireless, wearables, Wi-Fi, ultra-wide band, smart phones and location-based services,
- **Smart networked objects** - including technologies like RFID, MEMS, smart dust, digital ink and embedded computing,
- **Semantic technologies** - Semantic Web, XBRL, automatic tagging, affinity profiles and information extraction.

Although South Africa's share of the global ICT market is still small, this sector is deemed to be significant and a growing contributor to economic growth in domestic and export markets. Furthermore, the study considers the ICT sector as an important enabler for other industry sectors.

Of specific importance for the growth and continued development of the South African ICT sector are:

- Mobile technologies and devices,
- Wireless network technologies,
- Human Language Technologies (HLT),
- Open Source Software,
- Telemedicine,
- Geomatics, i.e. the gathering and processing of geographic information or spatially referenced data,
- Manufacturing Technologies–Robotics / Artificial Intelligence,
- Grid computing,
- RFID.

Especially the mobile technologies, HLT, wireless and OSS technologies are expected to present the most significant opportunities of the South African ICT sector.

Tourism

The shift of the tourism sector towards a greater emphasis on ICT was identified as a global trend. Although not wholly driven by ICT, the tourism industry needs to use ICT to improve productivity in reaching a broad and diverse customer base. The following technologies were identified as enabling sustainability and further development of the South African tourism sector:

- Mobile technologies enabling e.g. m-commerce, Geographical Information Systems (GIS),
- Wireless technologies,
- Internet,
- Human Languages Technologies (HLT), allowing the bridging of language barriers,
- Environmental technologies - including fuel efficiency, cleaner production processes, renewable resources,
- Cultural Heritage technologies.

The study highlighted the specific role of Internet enabling online transactions and marketing and allowing easier accessibility to information on a global as well as on a national basis. However, Internet was also identified as a potential threat to the South African tourism sector if the infrastructure and network are not improved. Further potential threats are: the lack of skills and knowledge, the perceptions of crime and violence, the environmental degradation, and currency volatility.

Chemicals

Different development paths are expected depending on the subsector. While specialty chemicals most likely will be significantly influenced by nanoscience and biotechnology in the future, the changes envisaged for basic chemicals (i.e. petrochemicals, bulk polymers and fertilisers) are thought to be based more on evolutionary development than on disruptive innovations. In this evolutionary development, the trend shifts towards cross-linkages between traditional categories of materials. Furthermore, most important global emerging technologies in the chemicals sector include materials technology, biotechnology and nanotechnology.

The study identified the following key areas with the major potential benefit for the South African chemicals industry:

- Extraction of minerals from coal ash and low value slag,

- Fluorine generation and fluorinated organic chemical intermediates,
- New performance chemicals improving the recovery of minerals in the mining sector such as polymer used in solvent extraction processes,
- Technologies decreasing economies of scale for chemical plants and hence enabling smaller production facilities to compete against the mega plants,
- Low-cost diagnostics and aroma chemicals production,
- Development of biodegradable and high-performance polymers,
- Bio-diesel and products from alpha-olefins,
- Generic pharmaceuticals for meeting future demand for antibiotics and/or anti-retrovirals.

Biotechnology

The study highlights the fact that South Africa has today only a very small bioeconomy and is still at the R&D level, despite of the widely use of biotechnologies in some industrial sectors including food and beverage, and waste water treatment. Most important areas for further development include the following:
- Recombinant therapeutic products and production of generic medicines,
- Vaccines against important infectious diseases such as HIV/AIDS, TB, malaria, rotavirus and diarrhoea,
- Diagnostics methods used for screening, diagnosis and monitoring or prognosis of diseases by laboratory methodologies,
- Commodity Chemicals from Biomass,
- Energy from Renewable Resources like plant biomass,
- Biocatalysts.

Functional genomics - with specific focus on gene expression analysis, **high throughput screening** - based on substantial bioassay development, **bioinformatics** - including biological data management and extraction, **biosafety** and **high throughput genome sequencing** are identified as common to these key areas and therefore deemed to be of highest priority.

Automotive Industry

Four technologies were highlighted as being critically important for the continuous development and growth of the South African automotive sector:
- Development of lightweight materials,
- Development of alternate fuels e.g. fuel cell technology,
- Sensors, electronics and telematics,
- Improved design and manufacturing processes,
- Especially the development of lightweight materials and electronics, sensors and telematics are deemed to be areas where South Africa can make an impact and possibly, hold a competitive advantage over the rest of the world.

Aerospace

Six critical technologies for the development and growth of the South African aerospace sector were identified:
- Development of composite materials,
- Development of hyper aero-thermodynamics,
- Development of Sensor usage,
- Health and Usage Monitoring systems,
- Noise Abatement,
- Improved manufacturing processes.

The study highlighted the strengths of the South African aerospace industry as a result of the strategic funding used for military purposes over the last forty years. Important pockets of niche expertise are composite materials and Health and Usage monitoring systems.

Metals and Minerals Sector

Little major innovation is expected in this sector as it is deemed to be already mature. The current technology trends seem more likely to be incremental improvements in the various value chain processes. Especially in the heavy metals sector innovation mainly concerns aspects like the improved use of gravel as a form of ore, the improved extraction of lower grade ore by developing improved reduction and extraction techniques and the more efficient use of energy. More innovations are expected in the light metals sector, specifically aluminium, magnesium, titanium and the development of alloys with focus on the development of a cheaper, continuous extraction processes for magnesium and titanium.

The study recommends focusing on:
- Light materials extraction,
- Alloy technologies, especially in magnesium,
- Process improvement.

Cultural Sector

The study regards the cultural sector, especially the crafts and tourism industries as a springboard for development with the potential to create jobs and develop less favoured regions. The most important challenges consist in enabling communication technologies, technologies, which improve the product and technologies that provide marketing to the end-consumer.

The following technologies with potential high impact on the Cultural Sector were identified:
- Product Technologies,
- Internet,
- Online Marketing,
- Mobile Technologies,
- Wireless Technologies,
- Advanced Materials,

- Human Language Technologies (HLT),
- E-Commerce,
- Environmental Technologies,
- E-Commerce,
- Portals.

Clothing & Textile Sector

The following global trends for this sector were identified:
- Increasing use of pervasive and ICT technologies, including internet and wireless technologies at every stage of the production process - telemanufacturing, e-commerce, etc. and in the end products (high performance, intelligent and technical textiles,
- Shift in demand-side away from the undifferentiated mass market towards more differentiated products,
- New technology developments in product traceability and identification guaranteeing quality and protection brand names,
- New value-added natural fibres and synthetic fibres due to technological advancement and therefore needs for higher skilled workers.

The study recommends focusing on:
- Intelligent Textiles,
- High-performance and Technical Textiles,
- Value-Added Natural Fibers - testing systems for foreign fibers in Mohair and wool; yarn formation; dying and finishing technologies,
- ICT for product and process improvement.

Processing of plant fibres - a growing market globally - is deemed as a potential critical niche market that South Africa is in an opportunistic position to exploit.

Agro-Processing Sector

The identified important global research and technological developments for the agro-processing sector are the following:
- Real-time detection of micro organisms in food,
- Sensors for online, real-time control and monitoring of food processing,
- DNA / RNA chip technologies to speed detection and analysis of toxins in foods,
- Food pathogen sensors,
- Separation modules that force molecules into confined environments,
- Real-time detection systems for verification and validation of intervention technologies used in Hazard Analysis and Critical Control Points (HACCP) systems,
- Better understanding of tolerable intake levels for nutraceuticals / dietary supplement components,
- Techniques to inactivate micro organisms to yield safer foods with extended shelf lives,
- Standardized edible food packaging films,
- Biological (e.g., bacteriocins) and chemical inhibitors to prevent or slow growth of pathogens in food,
- Technologies for food traceability.

Amongst the most critical for South Africa are technologies to enable food traceability and technologies to minimize food wastage.

Policy Impact

The primary purpose of this study was to inform and provide direction for further investigation and discussion and therefore not to set specific recommendations or strategies to be pursued with regards to investment or support for the development of specific technologies. However, the tourism sector, identified in the study as a springboard for South African development, belongs - besides the Business Process Outsourcing Sector - to the top priorities of the Accelerated and Shared Growth Initiative of South Africa (ASGISA) recently launched by the Government. This initiative aims at halving poverty and unemployment by 2014 by improving the economy's performance and job-creating capacity. Further priority sectors of the ASGISA, also highlighted in the benchmarking study, are the agriculture and agro processing field, including biofuels, followed by the Chemicals sector, the Metals sector, the Creative industries (crafts, film & TV, content and music) and the Clothing and textiles sector.

Sources & References

The South African study "Benchmarking of Technology Trends and Technology Developments" is available at: http://www.thedti.gov.za/downloads/developmenttrends/1executivesummaryTechnologydevelopmenttrends.pdf

Holtmannspötter, D., Rijkers-Defrasne, S., Glauner, C., Korte, S., Zweck, A. (2006). Aktuelle Technologie-prognosen im internationalen Vergleich. Übersichtsstudie. Ed. by VDI Technologiezentrum GmbH.
http://www.zt-consulting.de/technologieprognosen

Communication Media Spain 2018

Author	Cathrin Pagel/ cpagel@uoc.edu
Sponsors:	Fundación Observatorio de Prospectiva Tecnológica Industrial (OPTI)
Type:	National foresight exercise
Organizer:	Fundación OPTI, Ana Morato, anamorato@opti.org,Fundación EOI, Modesto Escobar,ICT, Institut Català de Tecnologia, Francesc Mañá, fmana@ictnet.es
Duration:	2003 — Budget: N.A. — Time Horizon: 2018 (15 years)

Purpose

The study aims to determine the evolution of social communication media in Spain within the next 15 years with special attention to the impact of new technologies in this area. The specific objective pursued by this forecast is to provide information that helps Public Administrations in their decision-making and companies in facing challenges of the future.

Diversity of Communication Media

The different media (press, radio, television and internet) analysed in the framework of the foresight exercise organised by the Fundación OPTI do not represent only different modes of sensorial perception, distribution channels, support types and geographical coverage, but also different social functions and levels of interactivity.

However; the hypotheses raised in the framework of this foresight exercise show that the situation of these characteristics may change in the next few years due to the impact of new technologies, such as digital, terrestrial television or broadband technologies. E.g., at present the broadcast mode for television is a one-to-many-relation, but the enhanced deployment of specialised information channels and the possibility to acquire contents in fragmented form will turn this relation into a one-to-one relation. These changes will have important repercussions on the business model of the companies operating in the media sector. The increasing demand for information on specific subject areas may constitute an outstanding business opportunity, especially for small and medium sized enterprises.

What Will be the Future of Traditional Media?

With the help of media experts, the foresight aims to explore the future of traditional media in Spain, such as press, television and radio, and the Internet in the next 15 years with special focus on the impact of new technologies on this sector. Therefore a great variety of aspects, e.g. technological development, social needs and trends, acceptance of new information supports, channels and formats, of new working methods, etc. have been subject to analysis. The study contains valuable information, which allows decision makers from public administration and the private sector to adopt the most appropriate strategies to face the challenges of the future and to stay competitive.

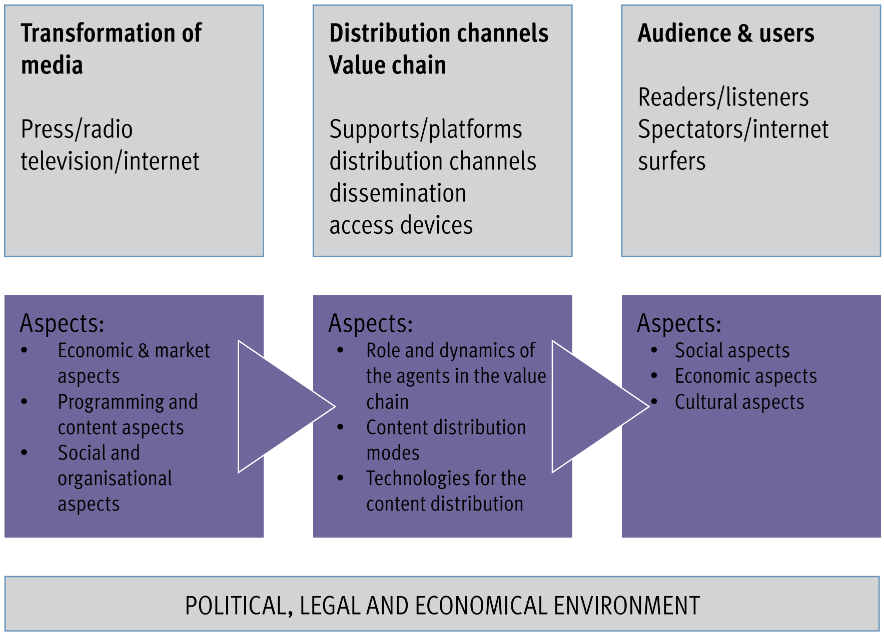
Assessing the Political, Legal and Economic Environment of New Media

The first step of the study consisted in the development of a conceptual model, which serves as reference model for the subsequent analysis on possible changes in communication media due to the impact of new technologies

As shown in the preceding figure, the conceptual model includes three main blocks, in addition to a forth block considering all those environmental influence factors not directly related to the media sector, but decisive for its future.

- Transformation of media.
- Distribution channels/value chain.
- Audiences/users.
- Environmental conditions.

Once the conceptual model was defined, a survey to validate a list of 41 hypotheses concerning the future of communication media, classified in four blocks, was dispatched to a large sample of experts and professionals of the communication sector. For each hypothesis, the respondents had to indicate the expected time frame: 2003-2006, 2007-2010, 2011-2015, after 2015, never. The following nine steps made up the



operative process of this fieldwork.

1. Creation of a panel of experts.
2. Definition of hypothesis on the future of communication media.
3. Definition of a Delphi survey.
4. Dispatch of the survey (1st round).
5. Processing of partial data.
6. Dispatch of the survey (2nd round).
7. Results of the survey (quantitative).
8. Discussion with panel of experts.
9. Composition of the final report.

Nine recognised professionals made up the panel of experts from the communication sector.

Transformation of Media

This first block of the conceptual model deals with the transformation of the four media analysed (press, television, radio and Internet) due to the impact of new technologies. It focuses especially on the following aspects:

Market and economic area - The tendency of merging media in big groups of multimedia communication will even be increased in order to reach the dimension required to be competitive in the market. In order to process information in different formats destined for different media, these new groups need to develop a strong **multimedia capacity.**

However their continuity in the market depends primarily on a successful **branding strategy.** Different product brands, which can be used across multiple platforms, will be created.

Advertising continues to be the main income source and will be oriented to the promotion of the **values attributed to the different brands**, what strengthens even more the power of brands. Nevertheless, the media groups are expected to diversify their income sources, e.g. by offering new services or through direct commercial transactions.

Programming and content area - The new communication media are based on a one-to-one concept (we can select what we are interested in) instead of the present one-to-many relation (take what we are offered). This new consumption model changes the focus of the prevailing supply-driven towards a smoother approach driven by demand.

Technological area - The immediate availability of fresh information will be appreciated more than analysis and journalistic investigation. The Internet with the deep transformation it has experienced to process and disseminate information is the best example for this immediateness.

Furthermore, for the period from 2007 to 2010, the implementation of a new generation of communication media accessible via broadband and via **permanent connections** is expected.

Social and organisational area - To keep up with new methods of editing and processing information, journalists and other professionals of the information sector must receive continuous training in multimedia technologies. This is necessary to increase the productivity, reduce costs and improve the competitiveness of the communication groups.

Furthermore use of new information and communication technologies will promote flatter organisation structures and hierarchies, which are necessary to increase the efficiency and the before-mentioned immediateness.

Distribution Channels and Organisation of the Value Chain

The second part of the conceptual model analyses the wide variety of supports and access devices offered by the existing distribution and dissemination channels for the different types of communication media. The emphasis of this analysis lies on the following aspects:

- Role and dynamics of the agents in the value chain.
- Content distribution modes.
- Technologies for content distribution.

Role and dynamics of the agents in the value chain: The content creation industry provided with distribution rights will constitute an important economic sector in the future. Already at present a convergence process between content creation companies and distribution networks can be observed. These mergers are aimed to generate added value for the companies themselves and their customers. The big press agencies will persist, although they will have to share the market with more specialised alternative information sources.

In the future the different types of media will coexist. However they will be used not only depending on the values they bring to users, but also depending on the daytime.

- Early in the morning – Radio.
- Morning – Press.
- Morning and Afternoon – Internet.
- Evening and night – TV and Internet.

Concerning the question if traditional newspapers will lose customers to digital press, the opinion of the experts is divided. Nevertheless they agree that the role of traditional press is changing, since it is used more and more often for opinion creation or entertainment and not as much as information support.

Content distribution modes. In the medium run, customers will have the possibility to purchase contents in fragmented form, what may open new business opportunity for small and medium enterprises specialised in very specific areas.

Digital terrestrial television will be enhanced by a growth in the supply of new contents and a larger number of free channels, while the knowledge of user preferences allows a customised content distribution targeted to specific audiences.

Furthermore advertising channels specialised in different subject areas or products may appear. Ads will be much more creative than at present and intend to create certain complicity with potential customers.

Technologies for content distribution: In the future a wide variety of technologies and supports for content distribution will coexist, although at the moment there are several obstacles, such as the allocation of frequencies and channels or the substitution of existing infrastructures and devices, which slow down the massive implementation of digital terrestrial television. Therefore a massive use of this technology is not expected before the end of this decade.

The deployment of broadband technologies in Spain has been a quite inefficient process, since technologies that could be installed quickly and at a low cost, such as ADSL, were preferred. In contrast, technologies with a much better performance and capacity, such as cable, were neglected.

In order to encourage rural development, public administration has to foster the deployment of broadband infrastructure in those regions with a low population density. The installation of wireless technologies is a good way to reduce installation delays in these regions.

In the short or medium run most households will own a single terminal provided with broadband access, which can be used as both, as TV and as computer.

Users as Readers, Spectators, and Internet Surfers

The third block is concerned with the audiences and users of the different media types: readers, spectators and Internet surfers.

Traditional newspapers hardly attract new customers among coming generations. General press is especially affected by this phenomenon, whereas specialised press maintains its sales, since new generations demand more specialised media that deal with their specific interests.

The audience will be subject to a continuing process of **globalisation and stratification**; i.e. the audiences of certain programmes have the same tastes and interests, wherever they live in the world. Therefore new media will offer programmes reaching out to specific publics and globalised, cultural elites. Knowing the profile of these audiences is a key factor for a programming and advertising successfully.

However, there are still many cultural and social barriers slowing down the deployment of direct commercial actions operated by new media like electronic commerce via digital terrestrial television (T-Commerce).

Environmental Conditions

The conceptual model is completed by an additional analysis of the political, legal and economic factors that may influence or directly affect the future development of communication media.

Legislative developments are far behind technological progress and social requirements. Especially the regulation of copyright demands the intervention of the legislator.

Regarding the formation of opinion it is assumed that the present situation will not change significantly, i.e. media keep on being the main transmission channel for the interests of different lobbies.

The (Digital) Media Divide

The transformation the communication media will undergo in the next 15 years due to the impact of new technologies on the sector will be determined mainly by five significant trends:

- Massive broadband access and permanent online connections.
- Advancement of communication media by replacing the supply driven focus by a demand driven one.
- Vertical integration of content creation industry and distribution channels.
- Possibility to access different media via the same terminal .
- Stratification and globalisation of audiences .

These are the main conclusions drawn from the study undertaken by Fundación Observatorio de Prospectiva Tecnológica Industrial (OPTI) in collaboration with Fundación EOI and the Instituto Catalán de Tecnología (ICT).
Some of the trends predicted are already underway such as the change of working methods in the area of media, information and communication.

The number of digital press users is increasing at a more rapid pace than the number of new Internet surfers. Additionally the number of electronic press readers starts to exceed that of readers of traditional newspapers. In 2003, when the study was completed, Spanish digital media had more than 2.6 million readers per day.

Digital media are about to become a threat to traditional media, since among the coming generations more and more users of digital press stop buying traditional newspapers.

However, the authors of the foresight indicate that all that glitter is not gold for digital press. The results of a survey on the labour situation of digital journalists reveal the instability and precariousness that most of them suffer from. The information user, in turn, takes a more and more active part in the content creation (e.g. when publishing a weblog). By doing so these new information agents are about to demonstrate that journalists are not indispensable. Therefore the pressure for journalists to adapt to the new media landscape and working conditions is extremely high.

In order to prepare future professionals to work under these conditions, universities should adapt their study programs to enhance multimedia and technological competences of their students. The ongoing Bologna process might be a good opportunity to introduce new contents into the curricula of future journalists.

Both, companies and professionals shall develop a greater awareness for the need of continuous training to stay competitive.

Sources and References

CMT-CAT (2002): La televisión digital terrenal en España. Situación y tendencias. Comisión del Mercado de las Telecomunicaciones y Consell de l'Audiovisual de Catalunya. Madrid.

DBK (2003): El mercado de acceso a Internet. Madrid. Estudio de mercado sobre los proveedores de acceso a Internet en España.

Portavoz del Gobierno (2003): Agenda de la Comunicación. La Moncloa. Madrid.

Insular Regions 2015

Author	Effie Amanatidou, amanatidou@atlantisresearch.gr, Tonia Damvakeraki/ damvakeraki@atlantisresearch.gr		
Sponsors:	European Commission, DG Research		
Type:	Trans-regional foresight exercise		
Organizer:	Instituto Techologico de Canarias, S.A. - ITC, Raquel Fernandez Horcajada, rfdz@itccanarias.org; FORTH - The Foundation for Research and Technology-HELLAS, Kostas Galanakis, kgal@stepc.gr; Consorzio Catania Ricerche, Francesco Cappello, fcappello@mediainnovation.it; CEIM – Centro De Empresas E Inovação Da Madeira. Patricia Caires, patricia.caires@ceim.pt		
Duration:	2003-2005	Budget: € 430 000	Time Horizon: 2015

Purpose

The path to the knowledge development model recommended by the EU is based on the progress of two main change parameters leading to a properly functioning knowledge society: research and innovation activities together with participation and clustering activities. Building on this framework the IN.TRACK foresight project aimed at formulating knowledge-based regional policies, ensuring the support of local actors and stakeholders through regional consensus, and raising awareness with regards to policy, industry and society as a whole.

Insular Regions in a 'Knowledge Society'

Pursuing the Lisbon goals and the creation of a European Research Area has specific implications referring to the role of the regions. Their increasing role is noted in EC policy documents in initiating efforts to support the transition of the Union to a knowledge-based economy and in becoming dynamic players in developing and structuring the ERA.

The insular regions of the European Union often lag behind the average performance of the EU's regions as far as knowledge and innovation performance is concerned. The knowledge economy represents both a new opportunity to be seized by the insular regions and a threat in terms of risk of a widening gap with respect to the more developed regions in Europe. Thus, a first challenge that insular regions are facing is the development of a coherent strategy for building and sustaining a knowledge-based economy and society building in their regional distinctiveness.

A New Approach to Regional Policies

A new approach to regional policies appears, which defines the competitive advantages of regions in terms of localised learning, the construction of networks of association and institutional spread. Regional policies must favour the creation of a *framework for interaction* in which companies, organisations and public agencies are able to explore joint solutions to problems shared in common, a framework in which, once dialogue has been established, attitudes that are more receptive to the interchange of information and interactive learning are generated. In this new context of regional policy, there are two main important institutional innovations regions should aim at: The **devolution of powers** from a national to a regional level; and the **delegation of certain tasks** of promotion and stimulation to intermediate organisations of a private and/or public nature.

The IN.TRACK project aims at developing regional policies for the four collaborating European regions - Canary Islands, Crete, Madeira and Sicily - aspiring the above theories, addressing the consequent challenges and following the policy guidelines in pursuing the Lisbon goals and the creation of the ERA. An extension of the blueprint to other European Islands - Balearic Islands, Azores, Sardinia, Corse, Highlands & Islands - is also envisaged for trans-national transfer of the model developed.

Pursuing the Lisbon Goals and the ERA through Regional Development and Cooperation

IN.TRACK has four main objectives:

- To evaluate the central role of knowledge in four less advanced European regions characterised by being an island through technology audits, strategic gap analysis and regional foresight,
- To diagnose the four regions' state-of-the-art in innovation

and technology policies and launch an awareness process enhancing the build-up of the "regions of knowledge" concept through four participatory and consensus-based workshops adopting the European Awareness Scenario Workshop (EASW) methodology,

- To ensure active participation of key cross-regional socio-economic stakeholders in order to generate a shared vision amongst the four targeted regions in terms of peripheral/insular knowledge-based development and policy options and lay the ground for new regional policies and plans of action focused on the Regions of Knowledge concept,
- To develop an inter-regional network, sharing a cooperative model and enhancing the exchange of learning and experiences through the development of shared and cooperative plans of action leading to self-sustaining blueprints, specifically addressing insular Regions' challenges in building knowledge-based development and innovative policy approaches.

Four Islands Facing Common Challenges

IN.TRACK adopts a three level strategy applied to the individual level (single island), multi-regional level (four islands under study) and multi-regional level (inclusion of other European islands). Participants involved key regional stakeholders such universities, research organisations, local authorities, trade unions, chambers of commerce, business associations and society associations.

Regional status in terms of knowledge-based development
As a first step the situations of each region under study was examined according to specific indication. In particular information on the regional economy (macro-economic data and trends), the industry fabric, and regional policy measures was gathered along with a series of specific indicators aimed at assessing the importance and significance of the knowledge-base underlying economic performance. The indicators were grouped under the following headings: information and communication technologies (ICT), intellectual capital, education, labour force, research and development, innovation within regional firms. The results show that despite the existence of structural gaps with respect to the mainland, the insular regions are catching-up and this is shown by the latest figures available.

In addition, a SWOT analysis was performed in each region in order to evaluate the regional context in which the development of the knowledge-based economy is shaped and planned.

Strengths – Research infrastructure, highly skilled personnel and attractive quality of life - The "strengths" side of the SWOT matrix reveals that Canaries, Sicily and Crete have a sound "R&D knowledge base" characterized by modern infrastructures, numerous research centers and institutes and dynamic universities. Furthermore, Sicily and Crete show close cooperation between universities and research centers and in Sicily also between research centres and companies. However, it is worth noting that this strength is not fully exploited since the gap between research and industry exists and is widening. Research and technological development is rarely translated into innovative solutions to be adopted by businesses. As far as the skills and the level of educational attainment of the human resources is concerned, the Canaries, Crete and Sicily count on a pool of highly qualified personnel. This strength needs to be "handled with extreme care" in order to be able to retain the qualified personnel and avoid the threat of brain drain.

A key factor characterizing the four islands economy is the major role of the service sector, especially tourism. The life style and quality of life in these islands can attract skilled personnel from abroad, creating a virtuous circle and a large pool of capable and competent individuals, which is one of the key factors for the successful development of the knowledge-based economy.

An additional strength characterizing Sicily, Madeira and the Canary Islands is their autonomous status, which implies independence in regional policy formulation, availability of funds, strong sense of belonging and cultural pride of the population, and strong bargaining political power.

Weaknesses: Distance, structure of local economies, research-market needs links, lack of funds - All four regions, except for Sicily, face a strong structural weakness as they are far away from the main European markets. In addition, the business tissue is fragile. It is predominantly made-up of small dimension companies (micro-firms and SMEs), often family owned, operating in traditional low productivity sectors and frequently disconnected from the R&D public system. The lack of competitive capacity of the regional economies is due also to the limited capacity of mobilization and attraction of funds as an alternative to the EU funding and to the absence of financial instruments and mechanisms as alternative to the bank credit.

Opportunities: Regions' strategic positions, ICTs, funding and biodiversity - Despite distance from the mainland, all regions are geographically located in strategic positions, favouring the interconnection with other countries. This is perceived as an important opportunity not only for the access to new markets but also in terms of potential links and cooperation abroad.

Besides, all regions are developing and taking advantage of services associated with telecommunication and information technologies. The opportunities that ICT offers to the insular regions are two-fold: On the one hand, the emergence of new businesses, products and services and, on the other hand, the application of ICT to the "traditional" sectors like agriculture and tourism. Structural funds help foster research and innovation. Moreover, transferring the technology and the knowledge produced in the research centres to the agriculture and tourism sectors would further contribute to their reinforcement and revitalisation, thus increasing their competitiveness. The biodiversity of the regions is an asset that may attract many researchers from all over the world and increase the wide range of technological options in the islands. This is especially true for Madeira and the Canary Islands, which show a considerable policy orientation towards the exploitation of the environment and the tropical traditional products.

Threats: Brain drain, sector competition as well as environmental damages - Apart from the difficulties to finance innovation - especially for Canary Islands, Madeira and Sicily - brain drain is also a factor of serious concern for the regions - specially stressed by Sicily. The regions should not only devote all efforts to avoid brain drain, but also put in motion the necessary mechanisms - reverse brain drain policies - to attract qualified personnel.

The increasing competition in the tourism sector from neighbouring countries is a common threat amongst the four insular regions. Additionally, all the regions have mentioned environmental damages deriving from over-exploitation as a major risk to be taken into account. Increasing competition in agricultural products from low labour cost countries has also been detected over the past years. For this reason it is very important to revitalise the agricultural sector and compete on the basis of quality and variety of supply rather than price, utilising ICTs and through the transfer of knowledge and technology.

Scenarios for a Knowledge-based Economy in the Four Regions

The analysis of the current situation in the four regions according to the knowledge-based economy, created a series of possible scenarios for the year 2015.

The CANARY ISLANDS will focus on the implementation of an electronic based **integrated neuralgic centre of information and advanced services for SMEs**, connecting offer with demand and generating synergies of added value and economies of scale. Furthermore, **mixed public-private technological centres of excellence** will be established in the region. The policy instruments will optimise the available local legislation opportunities and will be based on the optimisation of **fiscal benefits** and the concentration of highly qualified **service support infrastructure and risk capital for start-ups**. The region will become a **factory of knowledge and design**, diversifying its economy from tourism, avoiding its current dependence, and becoming the main supplier of technology to Cape Verde, Africa and America.

CRETE's vision is based on the enhanced delivery of **high quality and differentiated products** and services in the agriculture, tourism and services sectors integrating the **knowledge** produced in the research centres of the island. The vision is centred on **attracting talents** from the Mediterranean countries, the Middle East, China and India as well as on fostering a n**ew cultural paradigm based on awareness, consciousness and tolerance**. Finally, the vision sees Crete to have an electronic based system for services and business life that will reduce bureaucracy.

MADEIRA's vision is based on *"Madeira as an Island of nature and a Continent of Innovation with highly skilled human resources"*. The vision is built on the two important features: nature and innovation. The region wants to **match the opportunities** offered by the **domestic richness in terms of nature** and the **reinforcement of the educational and scientific achievement.** Another important feature of Madeira's vision is the **increase of the global level of innovation** for enabling the region to present new and value-added products. A strategic plan based on education and continuous training should be further developed in order to produce **highly skilled human capital.**

SICILY's vision is based on the goal of **exploiting knowledge** in order to become a more **competitive and dynamic region.** As outcomes of R&D investment will increase together with the number of new companies and "centres of excellence", investment in education will be enhanced both in quantity and quality and the **technical cooperation among companies, universities and local institutions will be strengthened.**

A Shared Vision for the Four Regions

The regional scenarios were then used as a reference to develop a shared vision in terms of knowledge-based development. This collective vision includes four main points, which are considered to be central for the vision of an insular region: The **diversification** of the economic activities in new areas and especially towards the direction of the information society; the **diffusion** of the innovation culture to the whole of the society; the d**evelopment of the social capital** of the regions; the focus on the **high quality of life** that the regions may offer.

Regional Development Based on Competitive Advantage and Social Participation

The common issues identified in the four regions are related to their structural conditions: biodiversity, geo-strategic position, isolation from main markets and environmental vulnerability. The fact of being members of the European Union allows a major availability of structural funds to build infrastructures for R&D, telecommunications and transport, which have increased the potential competitiveness of the regions analysed.

However, the persistence of low performance indicators related to the limited investment in R&D, the low number of qualified patents applied, the low number of spin-offs and start-ups, together with the adhesion of the new members of the European Union that will lead to a reduction in these funds, implies that a key challenge for the regions lies in the development of their differentiated capabilities in order to be able to compete in the global market.

In order to ensure a sustainable knowledge-based development, insular regions should focus on measures that guarantee continuous growth to overcome the **structural drawbacks** caused by the characteristics of being an insular region and that can be summarised in two approaches: the reinforcement of links between the private and the public sector to ensure the formation of a **cohesive local development system** capable to plan long-term commitments and goals and the promotion of a **cosmopolitan culture** within the region, fostering **international networking** and attraction of human/professional and financial resources.

Action Plans

An action plan for the implementation of the aspired scenario was then formulated for each region. These reports will allow policy makers to better identify and/or adjust the regions' strategic priorities and to make sound strategic decisions in the areas that are most critical for the creation of a knowledge-based economy i.e. institutions, education, information and innovation systems, development of key strategic sectors, technology development, legal framework and human resources development.

A precondition for this development is the establishment of a local research and innovation strategy mobilising all available resources and actors for operating subsequently in interregional networks. The innovative component is presented nevertheless in all action plans crossing them like a thread.

However, the action plans cover only one dimension of the framework of a knowledge-based economy. A second dimension, especially stressed by the stakeholders of Crete, deals with the **participation and awareness of the public in order to enjoy the benefits from these activities in the way of life.** The purpose of all these activities is the wealth of the citizens, yet, **if the results do not get disseminated, they will not be successful in the long-term.** The demonstration of effective approaches to innovation - by involving citizens and industry in the debate on technological choices - is a key issue.

Regarding governmental aspects, multi-level governance of associational and stakeholder interests has to be initialised in order to achieve a strong policy support for innovators, an enhanced budget for research, a policy leadership led by the regions' visions and a global positioning of local assets. Universities, research institutes as well as professional consultancies have to be involved in the structural improvement process so as to establish a knowledge-based infrastructure.

Pursuing the Shared Vision

The collective vision is the foreground for the development of a pilot action that is implemented by the four insular regions during the period January 2006-June 2007. The pilot action foresees the creation of an inter-regional network, its core made up of the four IN.TRACK partners. The purpose is to seek opportunities for further collaboration mainly by submitting proposals under the 7th Framework Programme. Several proposals were submitted out of which one was successful under the Regions of Knowledge programme. The network of the four core partners is expanded depending on the needs of each call for proposals.

IN.TRACK partners have expressed their willingness to transform this initiative into a successful and longstanding experience based on interregional cooperation and networking among insular regions and participatory consensus-based approaches in policy formulation.

Sources and References

Documents available at http://www.intrack.org

The Euro-Latin Foresight Network: SELF-RULE

Author	Rafael Popper/ rafael.popper@manchester.ac.uk, Yuli Villarroel, yulivilla@yahoo.com			
Sponsors:	European Commission, National Universities			
Type:	International network implementing Euro-Latin research, training and mobility in the field of foresight.			
Organizer:	SELF-RULE Coordinators (PREST & UNEFM), Members (in Europe: PREST, FFRC, U-ALICANTE and UNI-CORVINUS; in Latin America: UNEFM, UNEFA, UFRJ, ULIMA, UMOLINA, UNI, PUCP and UNIVALLE) and Partners (4-SIGHT-GROUP, DETRANS STUDIO, COLCIENCIAS and CGEE).			
Duration:	Since 2005 and ongoing	Budget: N.A.	Time Horizon: varies per activity	Date of Brief Production: August 2006

Purpose

SELF-RULE (Strategic European and Latin American Foresight for Research and University Learning Exchange) is an academic network for mutually-beneficial exchange of foresight knowledge, tools and experiences between the European Union and Latin America. SELF-RULE aims to build a sustainable foresight capacity in the member institutions by promoting and disseminating foresight initiatives and practices.

Promoting Foresight Research and Development in Europe and Latin America

SELF-RULE is an academic Foresight network operating in eight countries - Brazil, Colombia, Peru, Venezuela, Finland, Hungary, Spain and UK. While each country is represented by one academic institution, other national members can also be involved. The Universidad Nacional Experimental Francisco de Miranda (UNEFM) in Venezuela does the administrative coordination. However, the Scientific Coordination is lead by PREST together with the General Coordinator of the Network. The brief draws primarily on SELF-RULE activities, which are partly financed by the European Commission's ALFA Programme under the Cooperation for the Scientific and Technical Training Programme (Project Nº II-0468-FA-FCD-FI).

The overall mission of SELF-RULE is to foster cooperation, integration, innovation and exchange of foresight experiences between Latin America and Europe.

In doing so, the network aims to promote a joint and self-sustained long-term cooperation agenda through academic research, training and mobility programmes.
The three primary objectives of the network are:

- To build sustainable foresight capacities in Europe and Latin America,
- To exchange foresight knowledge, tools and experiences,
- To articulate academic institutions with other stakeholders of the regional innovation systems.

Having this in mind, the scientific coordination designed the network's activities around two complementary pillars:

- Foresight knowledge transfer and exchange.
- Foresight research.

Foresight knowledge transfer and exchange is carried out with the support of several technological platforms developed by network Partners (4-SIGHT-GROUP and Detrans Studio) with the contributions of the EC and network Members. Among these are:

- **Mobility Programme** - This programme provides 24 scholarships for travel and living expenses for the mobility of researchers.
- **E-Learning Space** - This space includes videos, conferences and presentations, thus providing e-training platform.
- **Virtual Mapping** - This platform allows Latin American members to map foresight experiences in Spanish. It is based on a contextualized version of EFMN Dynamo Platform.
- **Virtual Library** - The library allows members to share teaching material, reports and network related documents.
- **Virtual Forum** - The forum provides a common space for discussions and feedback among members.
- **Virtual Voting** - The voting/polling system is used to gather opinions about issues, which are relevant for the network.
- **Virtual News** - The network news are posted with the help of a dynamic and multi-lingual event calendar.

Foresight research activities are designed around 3 areas:

- **Foresight for regional techno-economic development** - These research projects normally address the potential of technological innovation for sustainable development. Accordingly, projects seek to position universities within regional systems of innovation, prospecting not only future contributions to regional knowledge production, but also linkages with other actors. For an example of such initiatives please visit: http://www.4-sight-group.org/self-rule/peru/uni

- **Foresight for regional socio-cultural development** - Work in this area will provide better understanding of the social and cultural dimensions and challenges of social change and transition (i.e. plurality of choice, individualism, creativity, uncertainty, life management, lack of vision vs. global views, etc.)
- **Evaluation of foresight experiences** - Research in this area contributes to increasing learning through foresight evaluation. Activities focus on questions such as: Who are the sponsors? Why have they initiated a foresight exercise? What are the objectives, duration, time horizon, budget, number of participants, methodology, etc.?

Building Sustainable Foresight Capacities in Europe and Latin America

SELF-RULE's 2005-2007 work plan included three major network meetings: Venezuela (2005), Brazil (2006) and UK (2007). The meetings normally consist of two days for conferences, seminars and events, followed by three days of internal and strategy discussions. While meetings have also been used to build capacities at host institutions and countries, the network's capacity building strategy is mostly based on the Mobility Programme and the e-Learning Space.

Mobility Programme

The network targets a total of 24 grant-holders with the following flows: **EU-LA** (from Europe to Latin America); **LA-EU** (from Latin America to Europe); and LA-LA (within Latin American). And the following mobility types:

- **Advanced Training (AT)** - The AT supports PhD (co-direction) and master trainings for periods of 6 to 12 months.
- **Short Term Training (STT)** - The STT supports studies within the scope of post-graduate programmes for max. 3 months.
- **Training of Researchers (TR)** - The TR supports visits of scientific nature for researchers for periods of up to 6 months.

e-Learning Space

The e-Learning Space is a web-based platform supporting online socialisation, information exchange and knowledge construction. The system uses a constructivist approach to learning; therefore it is learner-centred. There are two main areas: one for **VIDEOS, CONFERENCES & NEWS** (where visitors get access to relevant presentations and videos about network meetings and events) and one for the **E-TRAINING**, which includes the following categories:

- **Foresight Theory** - Training material on general foresight issues
- **Foresight Methodology** - Training material on practices and methodologies
- **Methods, Techniques and Tools** - Training material on specific methods, such as: scenarios, Delphi, etc.
- **Studies, Projects and Programmes** - Presentations about projects and programmes, such as: Brazil 3 Tempos and the UK TF Programme
- **Thematic and Sectoral Foresight** - Thematic and sectoral presentations in areas like: ICT, biotechnology, nanotechnology, etc.

Exchanging Foresight Knowledge, Tools and Experiences

Network Partners have developed a variety of web-applications for sharing and exchanging knowledge, tools and experiences. Two of these are the **Virtual Mapping** and the **Virtual Library.**

Virtual Mapping

SELF-RULE Virtual Mapping is a web-platform that helps to capture and analyse foresight experiences in Latin America. The system is currently designed in Spanish and is a based on further elaborations and contextualisation of the EFMN Dynamo Database. The mapping involves only four steps:

Accessing the system

Visiting http://www.4-sight-group.org/mapping and entering the personal information of the correspondent (name, organisation and e-mail)

Providing level 1 information about the activity

Country, title, type (exercise, conference, training course), territorial scope (sub-national, national, cross-border or international), and name of major programme or agenda the activity may be linked to.

Providing level 2 information about the activity

Executive summary, sponsor name, organisers name, date of initiation, end date, time horizon, number of participants, size of the budget, objectives, impacts, benefits, types of target audience, types of sponsors, methods used, types of products, types of impacts, and evaluation of impacts (quantity, status, effectiveness, examples)

Providing level 3 information about the activity

Related industries (using the NACE classification), economic sectors (based on the IPC classification), and research areas (using the OECD classification of the Frascati Manual)

Virtual Library

Access to the Virtual Library is granted only to network members, partners and observers; therefore visitors require a login ID and a password.

The library has several sections:

- **European Library** - Including documents in PDF, Word, Excel and PowerPoint formats about foresight mobilities, readings, teaching programmes and projects in member countries and institutions from Europe - Finland, Hungary, Spain and United Kingdom.
- **Latin American Library** - Including documents in PDF, Word, Excel and PowerPoint formats about foresight mobilities, readings, teaching programmes and projects in member countries and institutions from Latin America - Brazil, Colombia, Peru and Venezuela.
- **Network Meetings** - This section includes documents and information about major meetings of the network - e.g. Venezuela 2005, Brazil 2006 and UK 2007.
- **Network Mobilities** - This section contains one folder per mobility. Each folder has the personal information (CV) and other research-related documents of the grant-holder like research proposal, reports, etc..
- **Network Procedures** - This section provides access to important application forms and guidelines of the network - e.g. language support, expenses form.
- **Network Promotion** - This section includes leaflets, brochures, posters, presentations and other types of promotional material about the network.
- **Network Readings** - This section has several reading materials on foresight. Documents are normally provided by members, partners and observers - e.g. guides, manuals, handbooks, briefs, publications.
- **Network Reports** - Here is where major network reports are located - e.g. progress and intermediate reports.

People (members & observers) - This section includes general information about the people involved with the network - coordinators, national correspondents and other observers

The Virtual Library is built within the network's website and members are encouraged to populate their country and institution folders with foresight-related files. The following picture shows how the library looks like.

Articulating Academic Institutions with other Stakeholders of the Regional Innovation Systems

Within the limited scope of the network activities, some members have managed to undertake research activities - such as the Virtual Mapping - with the support and participation of other stakeholders of the regional innovation systems - e.g. S&T agencies, R&D centres, non-profit civil associations, governmental departments.

Members in Europe

In UK: PREST (policy research in engineering, science and technology) institute of the University of Manchester leads the overall Scientific Coordination of the network.

- Ian Miles (PREST Co-Director).
- Luke Georghiou (PREST Co-Director).
- Rafael Popper (Scientific Coordinator / Tutor / Resp.).
- Michael Keenan (Scientific Coordinator / Tutor).

In **Finland**: FFRC (Finland Futures Research Centre) of the Turku School of Economics and Business Administration.

- Heljä Kajander (Financial Manager).
- Anita Rubin (Tutor / Responsible).

In **Hungary:** FSD (Futures Studies Department) of the Corvinus University.

- Tamás Mészáros (Rector).
- Erzébet Nováky (Tutor).
- Bernadett Szél (Responsible).

In **Spain:** the University of Alicante.

- Antonio Marcilla (Vice-Rector of Research).
- Enric Bas (Tutor / Responsible).

Members in Latin America

In **Venezuela:** UNEFM (Universidad Nacional Experimental Francisco de Miranda) and UNEFA (Universidad Nacional Experimental Politécnica de las Fuerzas Armadas).

- Yuli Villarroel (General Coordinator / Responsible).
- María E. Gómez (Rector of UNEFM).
- Franklin Zeltzer (Rector of UNEFA).
- Rosalba Gómez (UNEFM Tutor).
- Gonzalo Acosta (UNEFA Tutor).
- María José Torres (UNEFA Responsible).

In **Brazil:** UFRJ (Universidade Federal do Rio de Janeiro).

- Belkis Valdman (Director of School of Chemistry).
- Luis d'Avila (Vice-rector).
- Adelaide Antunes (Tutor / Responsible).

In **Colombia:** UNIVALLE (Universidad del Valle).

- Iván Ramos (Rector).
- Javier Medina (Tutor / Responsible).

In **Peru:** ULIMA (Universidad de Lima), UMOLINA (Universidad Nacional Agraria la Molina), UNI (Universidad Nacional de Ingeniería), and PUCP (Pontificia Universidad Católica del Perú).

- Ilse Wisotzki (Rector of ULIMA).
- Luis Maezono (Rector of UMOLINA).

- Roberto Morales (Rector of UNI).
- Luis Guzmán (Rector of PUCP).
- Isaías Quevedo (Tutor / Responsible for Peru).
- Victor Guevara (Tutor / Responsible at UMOLINA).
- Edwin Dextre (Tutor / Responsible at UNI).
- Sandro Paz (Tutor / Responsible at PUCP).

NOTE: The list above indicates Members of the network's 2005-2007 work plan.

Sources and References

Villarroel, Y. and Popper, R. (2006) SELF-RULE Network: Intermediate Report, Coro, Venezuela
Internet Site

- http://www.self-rule.org
- http://www.4-sight-group.org

Children's TV Malta 2015

Author	Ioanna Garefi, Atlantis Consulting S.A./ garefi@atlantisresearch.gr
Sponsors:	Broadcasting Authority in Malta
Type:	National Foresight exercise
Organizer:	Broadcasting Authority of Malta
Duration:	2003-2004 / Budget: N.A. / Time Horizon: 2015

Purpose

Emerging media technologies and their impact on children's households may be singled out as one of the key emerging drivers of children's television. The National Broadcasting Authority of Malta initiated this foresight exercise, in order to identify the most important trends in today's children television programmes and how these can be improved. The findings of the exercise highlight a complex set of emerging trends and drivers influencing children's television in 2015, as well as a number of policy levers for improving television for children. Through the "Children's Quality Television" foresight exercise a number of policy insights and levers were identified which are currently leading to qualitative improvements in children's television.

Emerging Technologies & their Impact on Children

Emerging media technologies and their impact on children's households may be singled out as one of the key emerging drivers of children's television. Indeed this is reflected in the alternative scenarios and visions for quality children's television in 2015, which this exercise seeks to map and explore. Change is a constant factor to contend with in our daily lives and with products, processes and services, which are particularly dependent on consumer demand and ongoing technological improvements, such as media and television, the accelerated rate of change becomes even more evident.

The results of the exercise highlight a complex set of factors which together currently inhibit the improvement of children's television. These include shortcomings in resources, both fi-nancial and technical, as well as mindsets that are not always open for improvement. The results of the "children's television exercise reveal a number of emerging trends and drivers of quality children's television in 2015, including the attraction of adult television for children, the growing popularity of hybrid television programmes where parents can spend quality time with their children, children's need to feel that they can design and create their own television programmes, and the need for plurality and choice together with professionalism and quality in the television offerings, among others. These trends reflect the fact that children are becoming more mature in their tastes and needs at a younger age and expect to be treated accordingly even in the entertainment that they are offered. Indeed we have to come to terms with the fact that children today are far more selective than we ever were about the quality of television. This is a fact that has to be contended with and taken seriously into account.

Development of a Vision for Quality Children's TV

The aim of this foresight exercise was to complement rather than to replicate previous research. The exercise aimed:

- To explore alternative scenarios and to develop a vision for quality children's television in 2015,
- To motivate participants to identify roles for themselves in this vision,
- To instigate stakeholders to improve the quality of children's television programmes,
- To disseminate the concept of feasible quality television programmes for children,
- To provide criteria for the raising of standards,
- To provide the impetus for higher expectations on the part of both participants and others by means of initiating a dialogue on this topic.

Children's Involvement in the Exercise

This foresight exercise was conducted using simple foresight methodologies and tools such as scenario building, stakeholder mapping, consultation and focus groups.

The initial aim of using this methodology was to create visions of quality television for children in 2015. By proposing 2015 as the long-term time frame for this research, participants were given the opportunity to escape from the limitations of the current situation and, through the use of their imagination, to take a mental leap towards the future and put forward useful proposals.

Another important tool that was utilised in schools for this exercise was the **Edward De Bono thinking tool**. Edward de Bono is considered as the guru of 'creating thinking' and has developed many tools for teamwork and creative ideas. The main purpose for its use was an attempt to elucidate children's perceptions on popular television programs for children and on their vision for quality children's television. The thinking skills teachers and researchers employed by the Education division in state primary and secondary schools conducted these sessions.

In this exercise different stakeholders were identified so as to suit the different groups, bearing in mind constraints such as time factors and age. The main target group was identified as being children from 9-12 years old, as well as media stakeholders (mainly television) and postgraduate students participating in workshops and envisaging the future of quality children's television.

Children Included in the Formulation of Quality Standards

The researchers focused their efforts on clarifying what quality television for children implied. Their research on the subject exposed some key concepts concerning the quality of television nowadays.

They came to the conclusion that:

- Media could greatly influence young people's notion of a good life building on their values and concepts on how a good life could be understood,
- Television and other media give them the power to cope with all the difficulties in the future and to acquire strategies for acting on their dreams and hopes for the future,
- Pluralism in broadcasting implies a diversity of options and choices not only in products but also in the range of life styles and belief systems,
- Television has become an integral part of everyday life. It is no longer an intrusive force that acts as a threat to family values. It has become an important means of entertainment and saturation,
- Television has become an inseparable component of family life – evidence is its positioning in the living, eating and sleeping areas in our homes (media presence),
- Television is not merely another appliance like a cooker or a fridge. 'Family viewing' involves the operation of social power and influence, both within and beyond the family itself (power relations).

In this framework, quality television is defined as allowing children to participate and to play an active role in the programme and not just as spectators. Furthermore, quality television can take on the role of a mediator, meeting the needs and expectations of different child age groups. It also breaks the established rules of television and displays creativity and innovation through the variety of programmes shown. It may initially struggle against unappreciative audiences and may tend towards the controversial.

Foresight at Malta's State Schools

The children made use of the de Bono methods and simple foresight techniques in order to highlight what they considered as the most popular television programmes. This process helped to clarify their perceptions on quality television for children. The key outcomes from the sessions that were conducted in state schools in Malta have shown different insights across the different age groups. More specifically:

- Children see a good TV production as including action, surprises, music and other activities.
- Children demonstrate a real concern over appropriate content (no violence or reduce fighting, no lies, no killings, etc.) and often state that quality children's programmes should contain content suitable for children.
- Children are keen to learn through television and there is a strong preference for arts and crafts and life skills programmes.
- Children enjoy good and interesting stories and they are especially interested in fantasy and entertainment.
- It is likely that a number of children have difficulty in understanding languages other than Maltese and, possibly, also unusual accents, as some respondents said they think good quality programmes are those, which they can easily understand.
- Children recognise and learn from good role models and examples and claim to enjoy programmes where good prevails over evil.
- It is interesting to note strong elements of consistency across age groups regarding programmes that children en-joy watching and what they do not enjoy.

Moreover, a number of issues and concerns emerge from the analysis of the children's feedback. These include children's awareness of:

- The importance of education and learning,
- The ineffectiveness of bad language,
- The importance of programmes being suitable for children,
- Expressions of professionalism,
- Action and adventure as expressions of entertainment,

- Advertisements as being disruptive during interesting programmes,
- Humour and emotions as fun but not always educational,
- Actors, presenters and talent displayed as role models.

Pilot Focus Group - Malta Council for Science and Technology

The Malta Council created a pilot focus group for Science and Technology. This specific exercise provided valuable information about scenarios for quality television for children in 2015 and about the sound coordination of planned future research. The key results after the development of this pilot focus group related mainly to issues raised in the presentations and discus-sions between all the interested participants.

The ideas that emerged included:
- Integration of today's technology with TV,
- More personalised TV with greater choice,
- TV not as an information provider, but as an interactive instrument that could diffuse knowledge,
- Touch screens for use of DVD, music, games,
- Children's growing power to affect / alter a programme and to participate more directly due to interactive TV,
- Media education within school curriculum provides all the required opportunities for children to produce their own programmes with facilities available in schools such as editing facilities on computers,
- Changes in the way messages are delivered nowadays: live interaction could be achieved even today, e.g. through web cams for live intervention in real time,
- Use of multimedia technologies can allow children to participate, learn and follow lessons from home,
- Children's participation in TV programmes has contributed in increasing the confidence and creativity of children as reflected in their keenness to express their opinions more – at present Maltese children tend to keep back from expressing their opinion,
- TV on demand could result in less quality TV programmes, which may be forced to give way to programmes with mass audiences,
- 'Extreme' programmes bring out the worst in society – what values do these programmes promote? They raise both content and quality concerns. A leap to the past could provide a good scenario for the future,
- Advertising efforts have already shifted towards Internet.

Media Stakeholder Focus on Scenarios

Three focus groups were developed, composed mainly of media stakeholders. Their main aim was to make use of simple foresight techniques in an attempt to create alternative scenarios for quality children's television in 2015.

Apart from the fact that many limitations have risen during the session procedure, due to difficulties in encouraging certain participants to move into the future as well as the diminished turnout of participants at sessions. However, the whole focus group perception was able to move forward as planned.

Participants who were keen on producing great ideas about the notion of quality television for children in 2015 presented mixed scenarios. In some scenarios children were empowered to produce their own programmes and in other, children were projected as watching less and less television and indulging more in interactive sessions with other media – television being relegated to the background or totally eliminated.

All key stakeholders have stressed the importance of the **Hybrid TV** scenario, combining children's and family television, where both children and adults could enjoy quality television time. A second scenario emerging from these focus groups was the **Ambient TV** where television is embedded in our environment, and will also be more portable and personalised. Television programmes will compete with other digital experiences. For example, it would be possible for someone in Malta to interact with someone from the US or a child in the UK could easily play a game on television with a child in Malta and appear on television while doing so. A third scenario is the **globally interactive TV** where a quiz for children will be shared and enjoyed by several countries simultaneously producing an interesting situation on immediate communication. Last but not least is the **TV powered by children scenario** where children will have the advantage of presenting their own news programme. In this scenario, children will be the journalists and would send reports from their town or city.

The following issues emerge from the four key scenarios:
- Can there be better cooperation between schools and television productions?
- Should children be encouraged to watch more television given that they hardly spend any time outdoors and are already very busy with homework and private lessons?
- Should the public be given what it wants or are we bound to care for and encourage an appreciation of quality in children's minds?
- Language is still a big issue – programmes in Maltese exclude English speaking children and vice-versa.
- Will children's television still exist in 2015 given that children have a number of other more interactive possibilities such as web-chatting, web cams, web surfing etc?
- Should television be inward looking and utilise only professionals or outward looking and involve other media, new blood and international possibilities?
- Would parents or children recognise and appreciate quality children's television?

The University of Malta Develops Guidelines for Quality TV

A group of postgraduate education students of the University of Malta were brought together in a workshop and asked to develop and articulate their visions on quality children's television in 2015, using Edward de Bono methods and techniques. Important insights emerged including:

- Children should learn from television, so learning should be presented as fun.
- Children have a great opportunity of producing their own television programmes through media education.
- Programmes that show situations children can relate to in their own lives – case studies that children can actually live and experience themselves.
- Television programmes should be designed to build selfesteem by celebrating the unique abilities of children.
- Television schedules must dedicate some time to quality television for children.
- TV programmes should respect children's abilities and as they themselves can offer valuable inputs for making television programmes of higher quality.
- New technology could allow children to develop a more interactive experience when watching television.
- Television programmes supplement school education and science and technology education and learning-by-doing need to be featured more strongly, alongside regular education.
- Robotic and electronic characters could take over from traditional cartoon figures.
- Children themselves can present Science and history in a creative and fun way.

Awareness Raising and Follow-up Actions

Possible follow-up actions identified include:

- The results of this research should be disseminated not only among the stakeholders but also among the general public and the media.
- Further research should be conducted on the experience of other countries on this specific issue of quality television for children so as to pinpoint the major differences between different countries aiming to ameliorate the conditions followed in this issue.
- Media education and the use of television in schools for educational purposes together with the training of teachers and children in media literacy and media appreciation should be undertaken.
- The problem of lack of resources needs to be solved and opportunities such as EU funding must be explored for the promotion and exploitation of this issue.

Policy for Quality Required

Competition is healthy for the development of children. It creates challenges that motivate self-growth and a sense of responsibility. Politicians and policy-makers need to be made more aware of the responsibility of ensuring high quality public service television. More use should be made of other media for promoting quality television. The emphasis should not be solely on quality television, but on promoting a certain set of values that children respect and follow It was generally felt that television lacks direction or coordination and for this reason, the formulation of policy for quality television for children should clearly outline these aims and provide both strategy and direction together with aims and objectives.

The focus of the involvement of the main stakeholders in this foresight exercise was on television as a medium for education through entertainment. A range of opinions were expressed but two dominant aspects emerged, firstly standard patterns of programming such as sing along music programmes, quiz programmes, and secondly more interactive television and a virtual reality show with the participation of children and with educational content presented as part of the show. It is important to note that a number of issues that emerged in this research applied not only to local productions for children but also to productions for adult audiences.

Sources and References

http://www.eforesee.info

Dingli, S.M. and Cassingena Harper, J., January 2006, "Quality television for children in 2015", Research Paper commissioned by the Broadcasting Authority

Dutch Biotech Scenarios 2030

Author	Govert Gijsbers/ govert.gijsbers@tno.nl, Christien Enzing (TNO)/ christien.enzing@tno.nl, Wieneke Vullings (Technopolis)/ wieneke.vullings@technopolis-group.nl		
Sponsors:	Netherlands Commission on Genetic Modification (COGEM)		
Type:	Scenario Study		
Organizer:	TNO		
Duration:	Oct. 2004 – Dec. 2005	Budget: € 60 000	Time Horizon: 2030

Purpose

The purpose of the project was to gain insight in the future of biotechnology to support the work of COGEM, including technical and scientific risk analysis as well as the facilitation of public debate on biotechnology.

What Will Biotechnology Look Like in the Year 2030?

The Dutch Commission on Genetic Modification (COGEM) advises the government on the potential risks of genetic modification to human health and the environment. To perform its advisory tasks COGEM needs to obtain a broad understanding of the key factors in science and society that shape the future of biotechnology. To review possible future developments in a systematic manner COGEM asked TNO to carry out a project "Scenarios Biotechnology". The project was supported by a steering committee appointed by COGEM.

The key question in the scenario project was: "What will biotechnology look like in the year 2030?" Biotechnology was defined as modern with special attention to genetic modification. To answer this question the study explored a number of possible, alternative futures. The analysis included both a discussion on possible developments in society at large as well as more specifically in biotechnology.

Qualitative Assessment of Future Trends

The scenario process followed a number of steps:

- **Literature review.** The project started with a review of key documents on the future of biotechnology - medical, agro and industrial biotechnology - from a variety of sources, including research and foresight institutes, government studies, international organisations, private sector and NGOs.
- **Identification of trends and issues.** A distinction was made between generic trends and issues - societal, technological, economic, ecologic and political - and those specifically related to biotechnology. Key issues were summarised with an emphasis on – highly uncertain issues, rather than on more certain trends.
- **Scoring of issues and trends.** Next, all trends and issues were scored using two criteria: (un)certainty and impact. The purpose of this exercise was to identify those trends and issues with a high degree of uncertainty and expected high impact as the basis for the scenarios. The scoring was done by a number of COGEM members.
- **Identification of drivers.** Uncertain trends and issues were used to identify possible extremes to serve as a basis for scenarios. Several possible drivers/driving forces were considered including economic growth vs. stagnation; continued globalisation vs. regional/national development; government vs. governance; technology vs. user; and controversy vs. consensus in biotechnology. In consultation with the steering committee a decision was made to select one dichotomy expressing societal issues and dynamics and a second focusing on different developments in science and technology.
- **Building scenarios.** On the basis of the two key uncertainties four draft scenarios were formulated. These are discussed in the following section. The draft scenarios focused mainly on the generic aspects.
- **Stakeholder workshop.** COGEM stakeholders from science, industry, government and NGO's were invited to participate in a workshop that had two main objectives: to review and provide feedback on the draft scenarios; and to further elaborate the four scenarios, especially with regard to the meaning of these scenarios for biotechnology development, the opportunities and threats in the scenarios for the biotech sector and possible institutional changes. Participants worked in four scenario rooms and provided additional information and comments on medical, agricultural and industrial biotechnology, thereby enriching the scenarios. A cartoonist visualised the workshops outcomes and discussions.

- **Preparation of scenario document.** A final scenario document was written on the basis of the different sources of information obtained in the course of the project.

The Four Scenarios

The scenarios were developed on the basis of two fundamental drivers/axis:

The first axis is based on the uncertainty about the future role of **science and technology**. Here two extremes can be seen: on the one hand a situation where technology is a dominant and a strong driving force in society. At the other extreme a situation may develop where technology is mainly applied to serve societal needs. Technology dominance results from rapidly increasing investments in science and technology, which result in powerful scientific breakthroughs. These are accompanied by a high priority given to applied research, technology transfer, and other supporting policy measures. At the other end of the scale a situation is found where technology is mainly used in the service of individuals and society. This situation results from lower investments in R&D and is typical of a society with limited confidence in science and the scientific establishment. Individuals, organisations and networks play a role in setting the R&D agenda and in shaping technology for the benefit of consumers and society.

The second driver/axis describes **uncertainties about future developments in society**. The extremes of the society axis are two quite different images of the future: one is a situation that is strongly individualistic whereas in the other collective and public interests dominate. In the situation of individualism companies and individual consumers are key actors as producers and consumers of products and services. Markets are the key governance mechanism in this situation. The role of governments is limited to facilitating the proper functioning of markets. At the other end we find a situation, which is much more strongly steered by governments, public organizations and civil society. Societal goals often take precedence over economic goals and questions about environment, poverty, safety and exclusion feature prominently on the agenda.

In combination the two drivers present a matrix with four scenarios, each possible images of the future with a unique and different character:

- Tech-World
- Technoconsumer
- National champions
- Network society

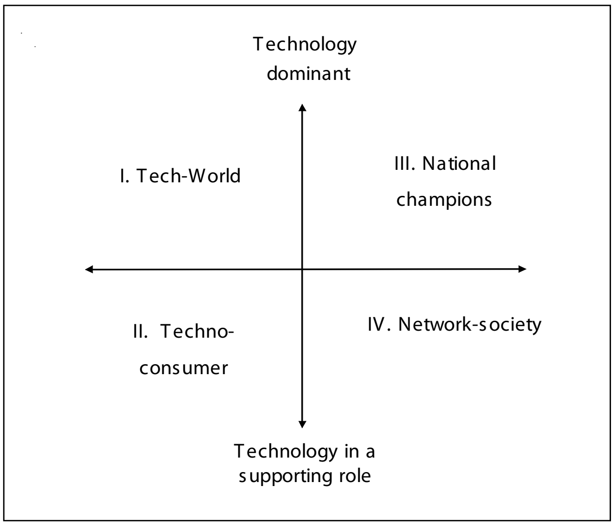


Figure 1: Biotechnology Scenarios

I. TechWorld

The TechWorld scenario combines technology dominance and individualism in a scenario of rapid technological development and market governance. Technology is everywhere: it is pervasive and embedded, and individuals are technology dependent. Globalisation has created worldwide-integrated markets for goods, services and technology. The role of governments is limited to market facilitation and creating a level playing field for actors to compete. National governments have transferred tasks to supranational governments and global institutions such as WTO. Openness and new technology have led to rapid economic growth, especially in Asia. China and India have become the engine of this Brave New World. For consumers high levels of economic growth mean that high tech companies produce a constant stream of new products that make life more productive and more comfortable. At the same time however many people feel that there is no escaping new and increasingly complex technology which is forced upon them and from which there is no escaping. Rapid economic growth in TechWorld leads to increases in emissions and environmental problems, which are mainly seen as technological issues.

In TechWorld biotechnology has made rapid advances. Technology-push by companies and small government have reduced regulatory restrictions on biotechnology research and development and has led to a situation with widespread acceptance of Genetically Modified Organisms (GMOs). Public acceptance of GMOs appears to be strong, but is in fact quite fragile, and may be shattered by a single crisis. GMOs also play an important role in industrial and environmental biotechnologies. Biomedical technologies play a key role in medicine and pharmaceutical companies and insurers play a key role in the adoption of personalized and preventive medicine in an effort to provide cost efficient health care to an aging population.

II. Technoconsumer

Free markets are also important in this scenario, but consumers play a key role in shaping and adapting new technologies. Companies have learned from the 1990s GMO debacle that they ignore consumer demands and societal concerns at their peril. "Lead users" and "early adopters" are increasingly involved in the development of new technology. Consumers and patients are very well informed and highly demanding with respect to new products and services. Companies have adopted small scale, flexible production systems that have turned the idea of mass customization into reality. Technology is ever more adjusted and fine-tuned to the demands and needs of specific groups of users. Many consumers however are overwhelmed by the endless possibilities and have to deal with the 'burden of choice'. Consumers often become producers especially in information technology related applications, where open source innovations have become the norm. Environmental problems are addressed through a combination of technological and institutional innovations such as individual tradable pollution rights.

In response to consumer demands life sciences companies have shifted their attention from improving producer characteristics to improving consumer benefits in GMO's. This has led to a range of new healthy and convenient products, which are readily consumed. GMO acceptance is no longer an issue as consumers widely consider the benefits to outweigh the risks. The genomics revolution has produced a large number of new 'personalised medicines', based on individual genetic characteristics. Life science and life style innovations have become increasingly integrated.

III. National Champions

Free markets and minimal government have not been able to address a range of problems such as climate change, persistent poverty, and safety and security. Governments and public organizations play a key governance role in society. Social and policy objectives are achieved through the provision of public services. European cooperation remains important but national interests play a more dominant role and national governments need to balance national and international objectives. Governments have placed innovation high on the policy agenda and play a key role in funding new technology and supporting national technology initiatives. Markets are regulated to promote competition between national players. Technology policy is based on national priorities and is used to support strong sector in the economy.

Governments have strongly supported the introduction of GMOs through the establishment of clear and transparent rules and by providing credible information to the general public. Biotechnology benefits from a coherent and transparent regulatory framework and the government's technology initiatives. Environmental regulation and fiscal incentives have provided strong support for the transition to a bio-based economy in which industrial biotechnology plays a key role. Medical biotechnology focuses on urgent societal issues such as obesity, which is becoming an ever-bigger strain on public health budgets. A genetic passport is prepared for every citizen and used to prevent disease, which is a key policy concern. For citizens it becomes increasingly difficult to escape genetic screening.

IV. Network Society

Governments play a smaller role in this scenario and public interests are mainly the concern of civil society organisations. Markets are regulated and stability and sustainability are key public concerns. Quality of life, wellbeing and individual freedom are important, but within acceptable and sustainable boundaries. Governance takes place through networks, where all stakeholders participate in decision-making. Decisions are broadly communicated and widely shared, although consensus building through participatory processes can be very time consuming. Technology development is steered by civil society. Learning by doing in "communities of practice" is important and social and environmental issues are high on the agenda. Users play an important role in innovation processes, either directly or through intermediary organizations, and transparency and communication reduce the uncertainty about new technologies. Confidence between science and society is restored in this scenario.

Bio-ethics questions play a key role in the Network Society. NGOs that remain strongly opposed to genetic modification receive broad support in public opinion. GMOs are not well accepted in this scenario and bio-safety remains high on the policy agenda. In plant biotechnology the emphasis is on technologies such as molecular breeding and marker assisted selection. Medical biotechnologies on the other hand are much more accepted: patients and their organisations play a key role in decision-making about preventive screening and testing and the use of pharmacogenetic technology. Public support for research on orphan diseases is strong in this scenario. Cloning continues to be a highly contentious issue. Industrial biotechnology receives strong support in this scenario. Sustainability is a key driver and it is realised that biotechnology can play a key role in the transition process to environmentally friendly bio-based systems. The use of GMOs remains limited to contained use.

A Bigger Role for Consumers and Patients

- The role of biotechnology differs in the scenarios. In most scenarios (with the possible exception of Network Society) it will increase considerably in importance.
- The nature of the biotechnology R&D process differs between the scenarios, especially with regard to the role of open source research, and the protection of intellectual property.
- Most scenarios indicate the possibility of improved confidence in biotechnology, which can however be fragile, especially when based on public ignorance as opposed to informed consent. Risk perception and assessment are key issues.
- Ethics will play an increasingly important role, especially in medical biotechnology.
- Governments will continue to play an oversight role in biotechnology, and will focus on achieving consensus on new technology.
- Freedom of choice and participation in decision-making will be important. The 'burden of choice' will shift increasingly to consumers and patients.
- International developments will remain quite uncertain: the controversy on globalisation and liberalisation will have important implications for the development, adoption and dissemination of new biotechnology.
- Industrial biotechnology and to a lesser extent agricultural biotechnology will play an increasingly important role in sustainable production.

As a result the future nature, role and place of biotechnology will differ considerably between the scenarios.

COGEM will use the scenarios as one of the bases for the new Biotechnology Trend Analysis report, presently under preparation and to be published in 2007. In addition COGEM is using the scenarios to support its longer-term foresight work on the future of biotechnology.

Sources and References

- Gijsbers, G.W., Enzing, C.E.,and Vullings, W. 2006. Biotechnologie in 2030: Vier scenario's voor de Commissie Genetische Modificatie (COGEM). Delft: TNO.
- Biotechnology Scenario's 2000-2050: Using the Future to Explore the Present. 2000. World Business Council for Sustainable Development Scenario Unit.
- Ministry of Research Science and Technology, New Zealand. 2005. Biotechnologies to 2025 Futurewatch.
- Institute for Alternative Futures. The 2029 Project source. http://www.altfutures.com/2029.asp
- Plant Research International Wageningen UR. 2000. Crops of uncertain nature.
- Brian Sager, Scenarios on the Future of Biotechnology, Technological Forecasting & Social Change, 68 (2001), 109-129.

Madrid 2015

Author	Emilio Fontela/ efontela@nebrija.es, Graciela Sáinz de la Fuente/ Graciela.Sainz-de-la-fuente@postgrad.manchester.ac.uk
Sponsors:	Comunidad Autónoma de Madrid (Regional Government of Madrid)
Type:	Regional Foresight
Organizer:	Enrique Morales, Consejería de Economía e Innovación tecnológica, enrique.morales@madrid.org
Duration:	2004-2005 · Budget: € 170 000 · Time Horizon: 10-15 years (2020)

Purpose

Madrid 2015 is an initiative promoted by the Regional Directorate of Economy and Innovation and carried out by this Directorate and the University Antonio Nebrija with the support from other Universities and Research Centres. This exercise, carried out during 2004, analyses the strengths and weaknesses of the region and initiates a collective thinking process that disentangles the key factors that influence the competitiveness of the region. The final purpose of this foresight project is to explore the possibilities for sustainable economic growth that the region of Madrid has, in order to anticipate possible futures and design long-term polices.

Madrid Embedded in a Changing Environment

Madrid is embedded in a changing environment. The region is generating new jobs and the economy is going through a period of considerable growth; its demographic pattern is changing, mainly due to large numbers of immigrants. The possibility of hosting the Olympic Games of 2012 generated great expectations and optimism among its citizens. These elements provided a positive environment for the region and were the starting point for Madrid 2015.

The favourable atmosphere of Madrid and the improvement in the quality of life are targets that the regional government is willing to maintain and improve. For this purpose, thinking about the future is a crucial element for shaping adequate strategies and defining long- term options for the region.

A Thinking Process for Madrid

This thinking process has been articulated in the form of a foresight exercise, structured in three stages:

The first stage is an analysis of the current situation of Madrid and a study of the factors of change that are affecting the present situation of the region and are possibly going to be important for the region in the future.

The second stage and core part of the exercise involves the definition of a desired Scenario for Madrid in 2015, as well as other future alternatives.

The last stage comprises the conclusion from the Scenarios, which are made to define future policies and strategies for the region.

Shaping the Path for a Desired Future

The main objective of this foresight exercise is to shape the paths that the region needs to follow in order to reach an optimistic and desired future in 2015. This desired future, as well as other plausible alternatives, are illustrated in the form of Scenarios. The Scenarios are built on the analysis of the current situation of the region - first stage of the exercise - and conclude with the elaboration of future strategies - outcome of the exercise.

This exercise uses the following tools: PEST Analysis (see below), SWOT Analysis, Interpretive Structural Modelling (ISM), Input-Output Analysis and Scenarios.

Regional Environment

To put the region into context requires the investigation of the environment, or the **P**olitical, **E**conomic, **S**ocial and

Technological forces (PEST Analysis) that drive the region. From these four, and due to their international relevance, the Economy, dominated by the phenomenon of **Globalization** and the Technology, strongly influenced by the **Knowledge Society**, are the two main elements on which this foresight exercise is based. But this analysis also takes into account other important elements: the European and the national dimension of the region.

Strengths and Weaknesses

Following the analysis of the environment, a **SWOT analysis** intends to define the opportunities and risks faced by the region. These tendencies influence the near future; but, as the evolution of the region is a dynamic process, these opportunities and risks cannot be understood on their own and need to be complemented by the factors of change that directly affect them.

Factors of Change

The analysis of the critical Factors of Change for Madrid takes into account two concepts: the **Knowledge Society** and the **regional competitiveness**. The Knowledge Society is relevant as the tradition of regions as producers of goods is shifting to regions as accumulators of knowledge. Regional competitiveness is also important, as regions are immense economic agents that compete like enterprises, offering tangible and intangible services to the productive sector.

The Factors of Change identified in this exercise are grouped in five categories: **infrastructures, social capital, human capital, technological capital and quality of life.** These are decisive for developing competitive advantage in the region

The study of the interrelations between the Factors of Change requires the use of an **Interpretive Structural Modelling** (ISM). This tool gives an idea of the factors that are most dependent upon other factors; if a factor of change is considered as "true", it would stimulate other factors of change.

A Model for Regional Growth

An **input-output analysis** studies the economy of the region, based on projections that establish linkages between demography, economy and industrial structure. This method provides a model of regional growth.

Scenarios

The final tools that shape the future of Madrid in 2015 are Scenarios. These Scenarios use as axis the exogenous dynamics of the region and its endogenous dynamics. The **exogenous dynamics** is composed by an articulation of four elements: globalisation, the enlargement of the European Union, the Spanish integration into the European Union and the Information Society. The exogenous dynamics range from an environment of opportunities to an environment of obstacles.

The **endogenous dynamics** deals with the capacity that public and private agents in the region have in order to get rid of the advantages or face risks. The endogenous dynamics varies from a positive to a negative climate.

The different combinations of these factors constitute four "extreme" Scenarios. The combination of the positive elements of the exogenous and endogenous dynamics constitutes the "Desired" Scenario for Madrid in 2015. These Scenarios intend to **draw the strategic lines** that the region needs to adopt in order to achieve a desired situation in 2015.

Who is Involved in Madrid 2015?

This project is lead by the Regional Government of Madrid and the University Antonio Nebrija, with the collaboration of other Universities and Research Centres. The stakeholders involved in the process are grouped in three boards: an International Advisory Board, formed by international experts in foresight; a Foresight Board, actively involved in the foresight process; and a Consultive Board that included representatives from different areas of government - industry, education, innovation, economy and transport. Additionally, an External Expert Committee gave input at several stages of the project.

Analysis of Factors of Change

The application of the different methodologies provides information of different nature:

The main factors of change were infrastructures, social capital, human capital, technological capital and quality of life.

The analysis of regional **infrastructures** revealed that these might be driven by the construction of a **second airport** and a **new high-speed train,** as well as the creation of public-private partnership for funding these activities.

Social capital provides an environment for the development of the region. Some of the identified factors of change that affected social capital were events like the **Olympic Games**; the mechanisms to prevent crime and terrorism and the establishment of a focal point in the region that established linkages with neighbour countries, especially with North Africa.

In terms of **quality of life** the results of the study revealed that there was an increasing number of **leisure and tourism activities**, but the region still lagged behind other European countries.

In relation to **technological capital**, the report saw that the delocalisation of manufacturing services could force the region to shift to more technological sectors. The linkage of the productive activities to R&D offered the possibility of positioning the region in an advantage situation in fields like **aerospace, ICTs and biotechnology**. In addition, the region was the principal financial region of Spain and could become in the future a **financial platform between Spain and Latin America.**

The lack of efficient **human capital** and the **brain drain** was a signal of the need of a **better university education**, adapted to the **entrepreneurial demand**. At the same time it was possible that the region was receptor of a high skilled immigration that contributed to the knowledge economy.

Factors of Change: Importance and Probability

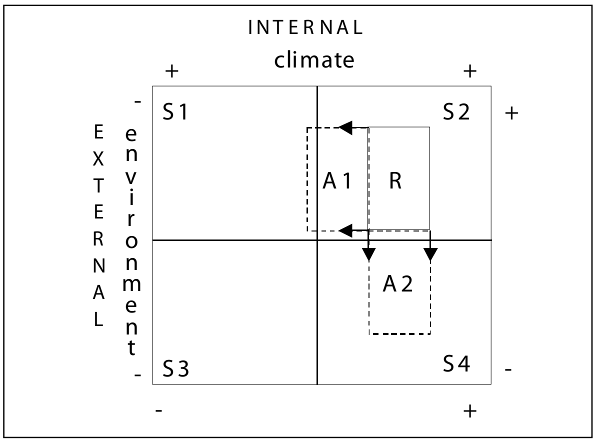
The experts provided their perceptions in reference to the factors of change above mentioned. These factors of change were later sorted by their importance and the probability to be materialised. Experts gave more importance to the factors affecting enterprises and entrepreneurship, especially in new technological sectors; and less importance to tourism activities, to the relations with North Africa and to the delocalisation of productive activities. In terms of probability, they saw as probable the investment in big infrastructures and the intensification of the financial sector. But, comparing importance with probability, the report concluded that the most important factors were not always the most probable ones.

The Interpretive Structural Model

A more detailed interpretation of the interrelation between the factors of change gave the following results. The most dependent factors of change upon other factors were:

- The formation of industrial clusters and clusters of services.
- The consolidation of technological clusters that are linked to the R&D activities carried out in the region.
- The higher concentration of regional R&D activities oriented towards new European policies.

The factors that had more impact upon the rest were the construction of big infrastructures for the region and the second and third issue from the previous section.



Input-Output Analysis

The economic model resulting from the input-output analysis concluded that the key areas for the regional economy were commerce, transport, personnel services, services to enterprises and real estate.

Benefiting from Global Growth or Suffering from Economic Decline?

The foresight exercise provides four "extreme" Scenarios (S1, S2, S3, and S4) and a "Desired" Scenario (R) that represented a favourable future for Madrid in 2015.

In the first scenario (S1) – environment of opportunities and depressive climate – the region is embedded in an environment of opportunities but a depressive internal climate prevents the social agents from getting advantage of the external opportunities. As a result, the region looses competitiveness.

In the second scenario (S2) – environment of opportunities and positive climate – an environment of opportunities and a positive climate allow the region to develop a competitive model that benefits from the national environment and the global growth and social welfare.

The third scenario (S3) – environment of obstacles and depressive climate – deals with a situation in which the region faces external difficulties and does not find the internal strength to maintain its model of growth. As a consequence the region suffers degradation in the economy, in the social welfare and in the environment.

The fourth scenario (S4) – environment of obstacles and positive climate – tackles a situation in which some difficulties encountered in the environment slow down the willingness of the economic and social agents to achieve a competitive position. As a result, the region looks for competitive niches and reinforces its mechanisms of internal development.

A Positive Future with Variations

These Scenarios are extreme and not necessarily very realistic, but they serve to position the region at present and delimit reasonable alternative futures. At the moment, the region of Madrid is placed in the most positive situation, the scenario 2. However, analysts consider as plausible a slight deterioration of this situation (A1 and A2) for the period 2005-2015 and therefore, they do not see it as feasible a do a simple extrapolation of the current trends into the future.

The positive evolution of the region over the past 10 years has provided the basis for defining the "Desired" scenario. This scenario would be embedded in an environment of opportunities and positive climate (scenario 2) and would be a continuation of the present situation. However, it is necessary to take into account some inflexion points as the linear projections are not always feasible. Therefore, in spite of the favourable past trends and the advantageous position of the region, this scenario necessarily considers eventual discontinuities reflected in two sub-scenarios.

This "Desired" scenario is built upon four main elements: new technologies, big infrastructures, tourism, leisure activities and culture, and financial system.
The "Desired" scenario is complemented with two alternative situations that are also situated in a sub-space within the scenario 2 but slightly overlap with scenarios 1 and 4. These alternative scenarios consider a decline in the variable climate and environment respectively.

The first sub-space (scenario A1) considers the deterioration in the social climate, especially in processes that accumulate social, human capital and quality of life. In this scenario the environment is still positive, but the decline of the social climate represents the failure of the competitive model of the region. The second sub-space (scenario A2) assumes a deterioration in the global, European and national environment. In this scenario the inner climate of the region is competitive but the external context does not contribute to its expansion. In this case, the technological and economic revolution as well as the globalisation fail; and even though the region demonstrates to have competitive advantage. This cannot be exploited globally.

Proactive Policies Required

The overall conclusion of the exercise is that the "Desired" scenario is the most attractive situation for the region of Madrid in 2015, but it requires proactive policies in several areas, from human, social and technological capital to infrastructures and quality of life.

A Normative Approach

As a normative foresight exercise, this document identified the essential elements that are required to achieve the desired situation in 2015. This desired future is driven by two main elements: Globalisation and Knowledge Society. These elements define two future desired options for Madrid:

- **Madrid, a "Cosmoregion" in 2015** - This option positions the region in the knowledge society. Under this situation, Madrid would be the geodesic centre for the Spanish speaking countries, and a central point for the South of Europe.
- **Madrid, a Science Region in 2015** - Madrid as a Science Region positions the region in the technology wave, dominated by areas like ICT, nanotechnology or biotechnology; and characterised by programmes for brain attraction, by the creation of high-tech start-ups and by the promotion of R&D on education, health and other scientific areas.

Contribution of Madrid 2015

The contribution of this foresight exercise can be summarised in three points:

- The exercise raised key issues for the region, with particular relevance for policy-making.
- "Madrid 2015" identified priority areas and ways for mobilising resources to act upon these areas.
- It identified the critical factors and key players in shaping the future.

A Continuing Process

This exercise is the starting point of a continuous foresight effort in the Regional of Madrid. The first up-date of the 10-year foresight is in process.

References

La Comunidad de Madrid. Prospectiva 2015. Dirección General de Economía. Conserjería de Economía e Innovación Tecnológica. Comunidad de Madrid 2005. All reports are available at **www.nebrija.com/prospectiva-madrid-2014/index.html**

Biotech Estonia 2020

Author	Tonia Damvakeraki/ damvakeraki@atlantisresearch.gr, Ioanna Garefi/ garefi@atlantisresearch.gr		
Sponsors:	European Commission - eForesee Project		
Type:	Thematic Action – Pilot Foresight Exercise		
Organizer:	Joint project by Institute of Baltic Studies and PRAXIS Center for Policy Studies		
Duration:	Jan 2002-Dec 2003	Budget: n/a	10-15 years (2020)

Purpose

The main aim of the eForesee project "Biotechnology Foresight in Estonia" (2002-2003) was to help develop innovation and industrial policy measures and elements in order to create long-term (10-20 years) possibilities of sustainable growth in biotechnology and related industrial sectors in Estonia. It focused on the development of institutional, economic and legal measures for the creation and sustainability of biotechnology as a new paradigm leading industry; through these measures, the management of various economic, developmental and social 'side- effects' – due to the development of biotechnology within and outside Estonia – were also achieved.

Trying New Tools for Policy Planning

This foresight exercise was launched as part of the EU-funded FP5 project eForesee and constituted a relevant forum for discussing the perspectives of biotechnology development in Estonia. Through this exercise many stakeholders were involved in a discussion, which reached above the daily policy process and politics and helped build a consensus about the options a small country like Estonia has on this field.

The project "Biotechnology Foresight in Estonia" was focused on analysing and forecasting the innovation and industrial policy development in the context of technology advancement in the coming 10-20 years and developing the innovation and industrial policy measures in discussion and cooperation with stakeholders from biotechnology industry, academic and political institutions. The exercise was based on constituting a new set of policy planning tools to be used more broadly by Estonian public, academic and private sector.

The focus of the pilot study was on biotechnology and it set out to identify the resources available for development of this sector in Tartu, in order to develop an action plan, building on the findings of the previous Biotechnology Foresight project for Estonia as a whole.

Economic, Political, & Social Aspects Considered

The project aimed at developing policy instruments to:

- Enable growth in **biotechnology as industrial activity** in Estonia taking into account its particular economic, political, and social situation. In economic and market terms, Estonia represents a small peripheral country. This brings both disadvantages as well as advantages – Estonia can equally loose out or win in the biotechnology revolution. Thus, it is pivotal to develop 'made-to-fit', yet flexible policy instruments, which will enable catching-up, re-orientation and re-allocation of human and market resources. This includes necessary changes in various fields from education to tax policy and financial capital as well as concentrated legislative efforts.
- Avoid possible "lock-in" and "crowding-out" effects inherent to a small economy via enforcing **increasing internationalisation** of academic as well as industrial activities. This means both bringing in researchers and companies from other countries as well as strengthening Estonian ties to the European Research Area.

The project also aimed at raising awareness about opportunities and threats of biotechnology in related economic sectors – and even remotely related – to biotechnology. This includes touching upon ethical and social issues as well as developing industrial policy measures, both horizontal and activity-specific, in order to prepare the economy and its social base as a whole for the biotechnology revolution. This will also help embedding biotechnology industry into the Estonian economic landscape without large-scale social irruption.

Creating a Learning Environment

For the implementation of the exercise, the creation of an effective learning environment for building the required theoretical and practical framework of different methodologies as well as familiarisation with best practices in other countries was considered as a prerequisite. Through mapping and co-nomination process, a list of 60 names who indicated their direct interest in the activity and their willingness to participate in expert panels and workshops in personal capacity. This meant that it was necessary to choose methods that would be suitable for smaller groups of experts with more active participation in the process.

On March 19th of 2002, the foresight exercise was **kicked-off** in Tartu and was attended by 50 persons representing policy makers, business and academic community. The kick off was initiated with laying down the strategic objectives, specific goals, timetable and methodological basis of the pilot exercise. An overview of other relevant foresight activities in Europe and elsewhere were given and the conclusions of various studies on biotechnology were presented.

The expert panels were asked to prepare a **SWOT analysis** of the sub-sectors of the Estonian biotechnology. Based on the relevant background of registered participants, **five expert panels** had been designated. Three of them were technology panels on biomedical, agricultural and environmental biotechnology respectively and two of them were policy oriented expert panels on economic and social aspects of biotechnology respectively.

The first task of the expert panels was to critically review the results of previous cluster studies on biotechnology and provide a SWOT analysis in the corresponding field. The results of each of the expert panels were later sent to other expert panels as well in order to ensure the coherent approach to the issues raised.

The next milestone had to do with the **scenario-drafting workshop** that was held on the 17th of April in Parnu. The main objective of this workshop was to agree on the main dimensions of the possible scenario development. Based on the results of the previous SWOT analysis meeting, the expert group started identifying both internal and external key drivers, trends and factors of change to have an expected impact on development of biotechnology. The identified factors were then linked in terms of importance and probability. Combining some of those factors with each other was used as a brainstorming session to identify the most relevant dimensions of the scenarios.

Will Biotech Become the Next Techno-Paradigm in Estonia?

It was finally agreed that the most important external dimension is whether the biotechnology will be the next techno-economic paradigm and most important internal dimension will be whether a viable biotech cluster will emerge in Estonia or not. Combination of those two dimensions will allow developing up to 4 macro-scenarios on the prospective development of Estonian biotechnology.

Yet, another **expert panel meeting** was held in September in Tartu, to discuss the technology trajectories of identified technological platforms of biotechnology in Estonia. The main objective was to analyse which technologies are still in the initial phase of development, which are rapidly developing and which are already in the phase of decline both at global and Estonian level, so that it would be possible to identify any major discrepancies with local and global development.

Finally, a **foresight conference** was organised in Taagepera on December, where the results of the biotechnology pilot exercise were presented to the relevant stakeholders. This conference was the chance for a final discussion on outcomes, which resulted in the **final report** of the eForesee Estonian pilot exercise. It was also agreed that this report would be used as an input for the preparation of the national strategy on biotechnology for the years to come.

When the foresight exercise was coming to an end in December 2003, Ministry of Economic Affairs and Communication took the initiative to start **preparing a national biotechnology strategy**. The outcomes of the foresight pilots in terms of conclusions and recommendations were integrated into the terms of references for the drawing up of the national biotechnology strategy.

Three Scenarios: Relocation, Human Resources, Internationalisation

Once the first draft scenario was prepared, many workshops were carried out in order to elaborate and further exploit them. A two dimensional matrix was chosen and three scenarios were extracted so as to illustrate the possible future. The first dimension was about whether biotechnology will be the next enabling techno-economic paradigm in the world and the second dimension was whether Estonia will succeed in developing a full-fledged biotechnology sector.

Three "possible scenarios" were developed according to the final pilot report:

- It is necessary to establish legislation and policy measures that will promote relocation of the medium-tech industries to the Baltic States.
- It is imperative for the government to facilitate development of strategic long-term technology roadmaps, and to provide support for the development of human resources so as to increase and enhance the levels of competitiveness of specific sectors where Estonia is possessing comparative advantage.
- Estonia is unable to compete in development of new platform technologies due to its small size. However, acknowledging the limitations of S&T foresight in a small and technologically backward country, one should focus in attracting investments on the emergence of new disruptive technologies internationally rather than specific domestic specialization.

Sharing the Experience: Biotech in Small Candidate Countries

An international conference on the topic of foresight on biotechnology in small candidate countries took place in September 2002. This conference provided valuable insights on general policy formulation as well as inputs to the pilot foresight actions to be implemented under the eForesee project. The specific objectives of this conference were:

- Contribution to the **policy formulation capacity** among policymakers and policy researchers in the Baltic States,
- Contribution to the **awareness raising** on the role of foresight in R&D management among biotechnology researchers and entrepreneurs,
- Development of the knowledge and understanding of policy makers and policy researchers in Estonian and the Baltics on issues related to the **implementation and design of foresight activities**,
- Discussion of all the relevant perspectives and challenges related to the development of biotechnology especially in **small candidate countries**,
- Discussion on how the establishment of the **European Research Area** will help in the formulation and coordination of RTD activities and policies in the biotechnology sector in small candidate countries.

Building Momentum

- The foresight exercise resulted in a clear vision on the determinants of Biotech innovation in 2020 and in detailed analysis of what are the most critical components enabling the vision to become reality.
- Biotechnology foresight contributed to the process of elaborating the **national strategy on biotechnology**, which will lay down the foundation for a national biotechnology programme. This process of strategy building has been integrated in the policy process since the first half of 2004.
- One of the direct results of the foresight activity was the still pending question whether the Estonian state should carry out a **national foresight** in order to set its **long-term priorities**, particularly having a clear need to increase the coherence and quality of the policy planning process for next implementation periods of the European Structural Funds. The example of the eForesee experiences provides a strong case for undertaking such an exercise on broader scale to generate input for the next National Development Plan.
- The foresight process included all the **major Estonian stakeholders from public, academic and the private sector** in the field of biotechnology. It is to be hoped that the common vision, which emerged from the exercise, will be carried on to various initiatives and programmes those stakeholders are preparing and implementing.
- For the implementation of the exercise, there was a close collaboration with the **Estonian Biotechnology Association**, which includes all the major Biotech companies in Estonia; at the same time, there was also direct involvement of academic institutions, which enabled foresight to become a catalyst for reinforcing or creating new partnerships in light of the discussion on development perspectives of the whole biotechnology sector.
- Foresight was extremely beneficial in terms of exploring the foresight methodology and providing basis for further foresight projects in Estonia. Tacit knowledge, which resulted from the process, was spread broadly over the wide range of stakeholders who can turn this into new foresight type of activities.

Recommendations for a Five-Year Period

In order to fully exploit the commercial potential of biotechnology in Estonia a dual approach is recommended aiming at both, to develop biotechnology as an important field in the high-tech sector, namely the biomedical area, and as tool to increase innovativeness of the economically more relevant low-and medium-tech sectors such as food-processing, wood-processing and the chemical industry. The proposed dual stage master plan of Biotechnology Implementation into Economy allows synergistic effects between the biomedical sector, which is already advanced in scientific and technical terms, and low-and medium-tech industries. This will allow us to miss-out the initial establishing problems in the latter. Additionally, it can be assumed that the two-stage strategy allows partly the external financing of otherwise internal costs.

A set of measures were proposed for a five-year period in order to improve the Estonian situation in three areas:

Knowledge base

- Set up a specific programme for interdisciplinary research in life sciences by the ESF - European Structural Fund,
- Provide specific funds for updating scientific infrastructures,
- Set up a programme for supporting the adoption of biotechnology in agro-food and chemical research units including funds for modernising infrastructures.

Education

- Establish business education centres at universities,
- Set up an education programme providing grants for international scholarships,
- Introduce industrial internships into master programmes,
- Develop and implement a modern curriculum for education technicians,
- In addition, interest of high school students for science and engineering should be improved by e.g. initiating awareness campaigns at schools.

Commercial development

- Establish science parks related to life sciences activities,
- Build up information programmes on marketing and business strategies for biotech SMEs,
- Set up a programme informing traditional industries about biotechnology potentials and providing advice for adoption,
- Set up a procurement initiative for the development of new or improved products based on modern biotechnological methods and tools,
- Initiate a round table for established financing institutions in order to increase awareness for high technology financing.

Upgrading Existing Industries, Investing in Niche Markets

The conclusions of the biotechnology pilot were mainly related to the timing and the development of the necessary public policy tools for the integration of biotechnology within the next 10-15 years.

In order to properly meet this challenge, instead of focusing on the advancement of commercial science and initiation of spin-off activities, greater public policy focus should be put in **upgrading existing industries.**

Estonia's current low national investment into high-tech industries should be exploited as a strategic advantage. As Estonia has no long-term high-tech industrial investments to defend, this gives the country freedom to be opportunistic by trying to **enter various new niche markets**. To exploit these possibilities, Estonia should proactively seek for ways to enter disruptive technology based on new markets via **targeting inward FDI** (Foreign Direct Investment) from non-traditional to Estonia investor countries in Western Europe, USA, East Asia and China.

To enable this strategy and to ensure also sustainability of Estonia's socio-economic development in medium-term, already now primary education and research policy focus should be put to **increasing human capital** provision in biotechnologies.

In terms of competence building, it is recommended to undertake mainstream activities of the European RTD programmes, especially those of the **Nordic countries** that have close trade and investment linkages with Estonia. In parallel to the participation in European Research Area, also active participation in the **USA and East Asian RTD programmes** should be favoured by funding Estonian successful participation in competitive projects from the National RTD funds.

Along with the above mentioned FDI strategy and subsidising choices of large companies, foresight processes and constant market research activities need to be embedded into the STI governance system as well.

Sources and References

http://www.eforesee.info
Final Report on Estonian Pilot No. 2 - The Biotechnology Pilot

Technology Foresight Slovenia 2020

Author	Peter Stanovnik/ stanovnikp@ier.si, Marko Kos/ marko.kos2@guest.arnes.si, Ioanna Garefi/ garefi@atlantisresearch.gr		
Sponsors:	Ministry for Science and Technology, Republic of Slovenia		
Type:	National foresight exercise		
Organizer:	Institute for Economic Research, Ljubljana, Slovenia, Boris Majcen/ majcenb@ier.si		
Duration:	2004 - 2005	Budget: € 65 000	Time horizon: 2015-2020

Purpose

The technology foresight study was conducted as part of the process of preparation for the mid term national R&D Programme 2006-2010 in Slovenia. This was the first national foresight exercise. It had several objectives: to promote the continuous forward thinking practice in society, to foster dialogue among main stakeholders in the innovation process, and to set preliminary R&D priorities for the future research and technology policy.

Post Accession Challenges

After gaining independence in 1991, the Slovenian economy has undergone radical socio-economic changes, from privatization of the business sector, introduction of new, market compatible institutional framework, adoption of EU «acquis communautaire» to entry into ERM2 (exchange rate mechanism of EU) and adoption of euro at the beginning of 2007.

The public sector, however, including science, high education, health services, and government administration has not been reformed according to the needs and challenges of the knowledge-based society. Next to the "Development Strategy", the preparation and adoption of the National Research and Development Programme (NRDP) is one of the key initiatives endeavoring to meet the new challenges according to the Lisbon agenda: to increase the volume and efficiency of the R&D expenditures and to enhance the competitiveness of the whole economy.

Key objectives of NRDP include:

- Increasing of public R&D investment to 1% of GDP by 2010 and attain research prioritization,
- Shifting balance of public research funds from basic, non-targeted research to targeted and applied research,
- Introduction of support measures to stimulate growth of R&D investment of the business sector to help achieve a 2% GDP target,
- Growth of number of researchers with Ph.D. in the business enterprise sector,
- Higher rate of establishment of new high tech firms, including the promotion of spin-offs from universities,
- Continuous participation in the international research community, especially in the ERA,
- Support of patents as an indicator of business' relevance to research,
- Growth of high-tech exports and of value added in the Slovenian economy.

Preparing the National R&D Programme

The underlying reasons for the adoption of new mid-term R&D programme were the following:

- Expiration of mid term R&D programme,
- Maintaining the strengths of the research system - developed public research and technological infrastructure, quality of scientific research, relatively high level of financial security of the public R&D sector,
- Overcoming the weaknesses of the research system - insufficient cooperation between public research institutions, lack of R&D prioritisation, low absorption capacities for technological innovation in the business sector, especially in SMEs.

According to the opinion of domestic and foreign analysts the implicit technology and innovation policies pursued in the past decade did not lead towards the enhancement of national competitiveness. That is why a new R&D programme with technological priorities and new innovation policy instruments had to be launched.

The objectives of the technology foresight study were manyfold. In the context of frequently changing and insufficiently co-ordinated R&D, policy measures are of particular importance to a forward thinking approach, which should be closer to the decision making bodies and to the enterprises. The main goal of the first technology foresight in Slovenia was to identify key technological areas – fields - relevant for Slovenian economy and society as a whole. One of the goals was also to intensify a dialogue between scientists in public institutions - universities and research institutes -, R&D actors in the private business and public servants. At the same time it was aimed at selecting within the chosen technological fields the most promising preliminary research fields in order to prepare a basis for future R&D and technology policy.

Delphi Tailored for a Small Country

The first phase of the Slovenian research in technology foresight was conducted in 2004. Its task was to give a preliminary identification of priorities for eight technological and societal areas. The areas of assessment were chosen on the basis of previous research studies and on the basis of experts' opinion.

The main method was a Delphi survey tailored to a small country. The respondents were asked to assess each of the technological priorities for eight areas - thematic fields. Moreover, they had to assess their own knowledge of each field.

The areas of assessment were the following:
- Information and communication technologies (ICT),
- Advanced materials,
- Biotechnology, pharmaceuticals, nutrition,
- Environmentally acceptable manufacturing,
- Sustainable construction,
- Traffic and mobility,
- Life-long learning,
- Medicine - care for the elderly.

The Delphi research involved over 2000 interviewees from the business enterprise sector - researchers from R&D units - and from academia - professors at universities and researchers from public research institutes. When assessing each of the research fields observed, they thoroughly analyzed the current state of the main technological fields in Slovenia.

The average rate of the received answers - almost 22% - was found satisfactory. The surveyed experts committed themselves in a very efficient way, to give their assessment of the priorities identified. Their list was set up on the basis of computer processing of the received answers to the questionnaire. They were classified according to their importance and share of high ratings.

The Delphi research was quite an accomplishment for the Slovenian innovation system as it was for the first time that the experts were faced with assessments of individual hypotheses over the various areas in an integrated way, i.e. individual hypotheses were competing against each other. This means that the actors involved in the Delphi had to study in a more serious and broadened way not just their own restricted field of expertise, but also that of other experts. The selection of the areas was made on the basis of evaluation of importance of individual areas and on the basis of studies conducted in comparable countries. This turned out to be a good solution as it permitted all the most outstanding and vitally important areas to be included. In the second phase of the research it will be necessary to deepen the investigation and to narrow the scope of technological theses.

The evaluation questions / criteria were as follows:
- Knowledge of the respondent,
- Innovation level of a particular research field,
- Importance of development - of a particular research field - for Slovenia,
- Prospects for accomplishment of the research field within the period of the next 10-15 years,
- Development stage,
- Possibilities for Slovenia for assuring one of the leading positions - within a particular research field - with regard to its R&D stage,
- Possibilities for Slovenia for assuring one of the leading positions - within a particular research field - with regard to the organisational transformation,
- Possibilities for Slovenia for assuring one of the leading positions - within a particular research field - with regard to the economic use in terms of new products / services,
- Economy's preparedness and willingness to invest in a particular technological area.

From ICT to Care for the Elderly

The selected thematic fields proposed by expert panels are very much in line with the priorities of 6th and 7th Framework Programme of the EU. Due to the small size of Slovenian economy and limited R&D potential the proposed thematic fields should be verified and narrowed in the forthcoming investigations.

Information and communication technologies (ICT) rank as the most important among the key technologies because of its dominant role in all manufacturing and service industries. It deserves a continued special attention due to its economic and social relevance not least for innovation. ICT is important for its inherent cross-disciplinary and cross sectoral nature and for its new ways of producing, trading and communicating. In the period 1995-2002 the

Slovenian ICT market has grown considerably (17.3% yearly growth rate). In 2003 the share of ICT value added in the business enterprise sector has reached 8.2%. The selected technological research fields for Slovenian economy range from intelligence networks, broadband systems to bioelectronics and optoelectronics.

Next to ICT **biotechnology** was one of the Delphi priorities in the survey. It is possible to classify biotechnology applications into three fields: health related, agriculture related and industrial biotechnology. Biotechnology is based on several scientific disciplines and can affect different industrial sectors. In all these three applications Slovenian economy has due to its relatively small size limited potentials. However, pharmaceutical industry is at the pinnacle of the Slovenian economy and the leading exporting industry. The foresight exercise has stressed the need of collaboration among all important market players - pharmaceutical and food processing companies, universities and research institutes - in order to achieve a critical mass of knowledge, experience, personnel and financial resources. The selected research fields range from generic pharmaceuticals, delivery systems to tissue engineering and new production processes in pharmaceutical and food processing industry.

Manufacturing industries as the main exporting sector was the third field analysed. They comprise the processes and entities required to create, develop, support and deliver products. Manufacturing spurs demand for everything from raw materials to intermediate components to software to financial, legal, health, accounting, transportation and other services in the course of doing business. The manufacturing system in Slovenia has considerable economic, social and environmental significance. Presently, manufacturing contributes to almost 23% of Slovenian GDP, 26% of gross value added and 29% of total employment. The selected research fields encompass air, water and sea protection, waste management, renewable energy resources etc.

The priorities identified for **advanced materials** range from intelligent materials with sensor and actuator capacities, polymers, and multifunctional materials to nanocrystalimic materials. Transport and construction services have developed in Slovenian economy parallel with the process of shrinking manufacturing industries. The selected research fields in the **sustainable construction** sector are oriented towards energy and cost effective technologies, better work organization and pre-fabricated construction systems. Slovenia as a small transit economy is very much concerned with the improvement of transport systems and **transport** infrastructure by using environmental-friendly technologies, better combination of road, rail, air and shipping.

Education and **livelong learning** has been perceived as an important element of the national development strategy. The research fields selected focus on better learning organization, establishment of networks for adult education, and the partnership between public and private educational systems.

In an ageing society **care for the elderly** people is of most importance. The research fields point out different prevention methods, early diagnostics and organization of specialized expert systems.

Implementation Gap and Follow-up Activities

The first round of technology foresight study in Slovenia identified eight broad thematic issues - six technological ones and two of broader societal nature. All these themes proved to be relevant for the present mid-term and the future long-term R&D and technology policy. The conduct of the technology foresight and the main findings of the study raise attention to issues important for policy making - closing the so called implementation gap, further narrowing of R&D priorities, change of institutional set up in S&T system - and follow up activities.

In several post transition countries and in Slovenia too, there is an »implementation gap« between the leading national documents – influenced by top political elites and by academic lobbies – trying to preserve status quo in R&D and in innovation systems and the needs of innovation, market oriented globalised stakeholders. It is an important challenge how to close this gap by means of an efficient vertical and horizontal integration of all governing levels and by means of reaching consensus in R&D priorities. The deficits perceived were weak co-operation between public R&D sector and the private business enterprises, uncoordinated and unstable policy measures in the field of science and technology, and inappropriate institutional structure. If these trends continue undermining the on-going reforms in Slovenia, the targeted foresight of the knowledge based and globally competitive society will not be attained.

Judging from the strengths of the Slovenian innovation system - high shares of public and private R&D expenditures, numerous bridging institutions like technology parks/ centres, clusters, incubators, different support schemes for innovation, intensive participation in international R&D projects - and from weaknesses found out by the domestic as well as foreign analysts - technologically lagging behind the developed EU countries, low level of industrial specialization, fragmented R&D - three main targets have been achieved by the foresight exercise:

- The main existing and emerging technologies, i.e. technological research fields, were identified. They are useful for conducting an adequate Slovenian R&D and technology policy. They are further appropriate for directing institutions finding a balance between demand-pull and technology push.

- The importance of the connection and continuous dialogue between public research and private business innovation activities was highlighted and the necessity of institutional changes was emphasised as being a precondition for both by increasing the orientation of the public research sector towards market driven R&D efforts.
- Analytical background was provided for further foresight research - 2nd Delphi round – by highlighting R&D and technological priorities to carriers of political decisions and top enterprise management.

The research was conceived in a way that enabled collective learning. It made a free exchange of ideas feasible. The process thus qualified itself as a public learning procedure into which new ideas were initiated. Broad horizons in eight research fields were chosen. A selection of the most promising ones was made.

The answers obtained were grouped according to R&D potentials and economic evaluation. One of the study results was also that there were determined those research fields and technological research fields, which most likely will need some kind of governmental support.

Following the experiences gained through completion of the first phase of the project, the conclusion was made that it is necessary to also carry out the second phase of the research in order to verify selected technological theses and to obtain consensus of all the participating experts and institutions without any considerable dispersion. The same position has been taken also by researchers in other countries where the second phase was regarded as an integral part of the overall project, which for this reason lasted 2-3 years. It was also noted that it was necessary that the institution that had conducted the TF project participated in the process of project implementation. In addition, it is important that the governmental administration, Chamber of Industry and Commerce of Slovenia, public media and non-governmental organisations participate in the second phase of investigation.

The foresight exercise in Slovenia addressed the current vacuum in long-term visions for Slovenian research and technological development and created better understanding of the evolutionary paths of key technologies. At the same time it created a bridging role from national research activities to 6th and 7th European Framework Programmes. It developed more bottom-up approaches in order to identify long-term research and technological priorities for Slovenia.

Sources and References

- Aichholzer, G. (2002). Delphi Austria: An example of tailoring foresight to the need of a small country (In: UNIDO, International Practice in Technology Foresight, 125-145), Vienna.
- Cuhls, K. (2000). From Forecasting to Foresight processes – New participative Foresight Activities in Germany. In: Cuhls, Kerstin und Salo, Ahti (Guest Editors): Journal of Forecasting, Wiley Interscience, Special Issue, no. 22 (2003) 93-111
- Foresight Methodologies (2003), Training Module 2, UNIDO, Vienna.
- Havas, A. (2003). Evolving Foresight in a Small Transition Economy. Journal of Forecasting, March/April 2003, Vol. 22 Issue 2/3, p. 179-201.

Dutch Hospitality 2020

Author	Joost Hoogendoorn/ joost.hoogendoorn@tno.nl		
Sponsors:	Dutch Board for the Hotel and Catering Industry		
Type:	Single foresight exercise on hospitality sector		
Organizer:	TNO		
Duration:	2005-2006	Budget: N/A	Time horizon: 2020

Purpose

The Dutch Board for the Hotel and Catering Industry developed an online innovation database with innovations currently available for the hospitality sector. However, due to the large amount of new products, services, processes and business models identified there is no overview. In addition, the database is centered on innovations already available within the hospitality sector, while the large part of innovation origins from related sectors. The further development of the innovation database questions a wider view on several sectors to conduct an overview of the major developments in innovation within the hospitality sector.

Innovation Platform

The Dutch Board for the Hotel and Catering Industry functions as the knowledge and innovation centre for the hospitality sector in the Netherlands. Within the scope of innovation monitoring, they initiated a digital innovation platform for all stakeholders in the hospitality sector. This website **www.horecainnovatie.nl** is basically centered on an online innovation database containing approximately 700 innovations, identified by stakeholders within the sector.

Due to its success, the database encountered two major challenges. First, due to the large amount of innovations there is no overview. Relevant innovations are hardly recognized and the risk of getting doubles is increasing. Second, the database is centered on innovations within the hospitality sector, while the large part of innovation origins from related sectors like the food industry.

Towards a Complete Innovation Overview

To overcome these challenges and to enable a further understanding and development of the innovation database a foresight exercise was issued, containing the following two objectives:

- **Insight in innovative developments in related sectors** - The restricted scope to the hospitality sectors of both the stakeholders and thereby the knowledge on innovation questions a wider view on innovation in related sectors. The aim is to conduct an overview of the major developments in innovation currently approaching the hospitality sector.
- **Structuring of innovations within the database** - To overcome the information overload on innovation currently available an overview is needed. This overview also enables a further top-down search on missing relevant innovations developed within the sector and more important, approaching the sector.

'Syntegration' of Innovation Concepts

For the structuring of innovations a concept was needed, which contained several aggregation levels of innovation to acknowledge the main innovative trends within the hospitality sector. The so-called Dynamo framework of future developments is used here (figure 1).

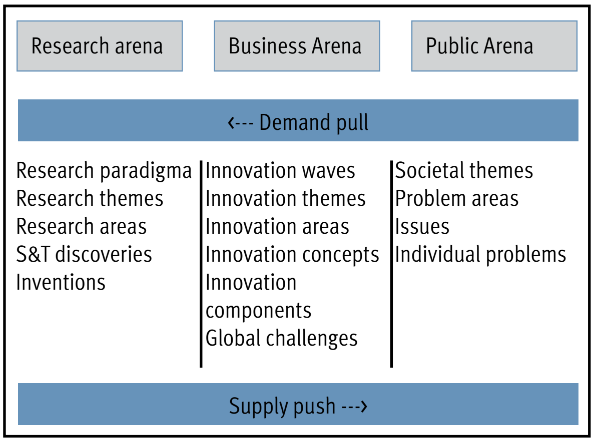


Figure 1: Framework for future developments

This framework is designed to 'syntegrate' developments, i.e. cluster on their core subject. In case of innovations, structuring takes place based on renewal. Innovations or innovation concepts can be syntegrated into innovation areas if they are directly related in the sense of competing with or complementing each other. Innovation areas can be aggregated to innovation themes, which are basically the thematic renewal approaches within a specific sector.

Methodologically, the foresight exercise contained the following three steps.

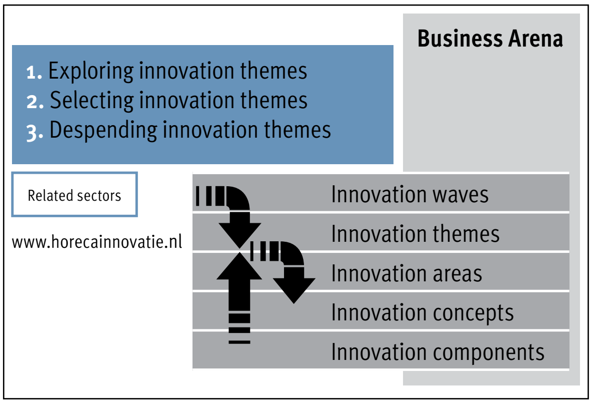


Figure 2: Approach Horizon scan Hospitality sector

- **Innovation themes are explored** based on foresights and research programmes in a broad range of possible related sectors. Based on potentially relevant innovation waves, candidate innovation themes are explored.
- **Innovation themes are selected** based on innovation concepts already identified within the hospitality sector and by questioning 42 experts of the hospitality sector.
- **Innovation themes are made more concrete** in underlying innovation areas, which are identified based on foresight studies, research programmes and innovations currently available.

Scanning the Horizon

In terms of innovation, the hospitality sector is mainly related to the food industry, construction, recreation and tourism and communication, business and logistics. Figure 3 shows some topical innovation themes in these related sectors. Innovation themes are thematic approaches within innovation waves mentioned later.

The food industry is mainly developing towards **safe and healthy food**, while also the **convenience consumer** is in the picture within the food industry. Convenience is also the main topic for the recreation and tourism sector. The construction sector is evolving towards **smart buildings** enabled by advances in technology, while the public and the government are inducing **sustainable building and construction**. Finally, the **information society, network economy and new business models** are evolving from telecommunication and related sectors. Innovation waves like sustainable energy, smart consumer electronics, sustainable regions and efficient and effective health care also have some relation with the developments within the hospitality sector.

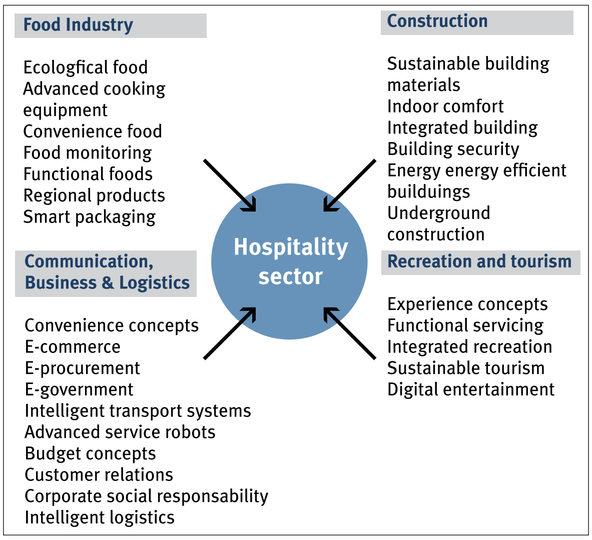


Figure 3: Related sectors along with their innovative themes

Selection of Innovation Themes

The identified innovation themes are checked on relevance by the occurrence of characteristic innovations, and time and impact by experts of the hospitality sector.

The 700 innovations within the database of the hospitality sector show a nice resemblance of innovation themes currently topical. In total, 24 innovation themes can be recognized within the database. Experience concepts and advanced cooking equipment are nicely represented by around 70 innovations. Surprisingly, corporate social responsibility is third with 53 innovations, followed by convenience food, e-commerce, e-procurement and integrated recreation all accounting for 40+ innovations. Based on the innovation themes covered by the innovations in the database, a strong relation can be found with the food industry, recreation and tourism sector.

Surprisingly innovation themes like home automation, spatial concepts and advanced service robots are not covered, while they are already in practice in the hospitality sector or indicated relevant in the future by future studies. Striking is that the hospitality experts also indicate these topics as non-topical and having hardly any impact.

According to the experts of the hospitality sector convenience food and **experience concepts** are very topical and have a large impact. Also topical, but intermediate impacts have **corporate social responsibility, local products and functional** servicing. On medium-term **intelligent logistics, e-procurement, e-commerce** and **food monitoring** will have a large impact on the hospitality sector.

Based on the innovation database, hospitality experts and literature, 26 innovation themes were selected and assigned to the front office or back office of a hospitality firm. Innovation themes in the front office refer to external renewal, focusing on the customer, while the back office refers to internal innovation. Only three innovation themes were indicated as relevant for both the front office and the back office.

Innovation Radar Front Office

At the front office of a hospitality firm, clients are generally offered three types of services: accommodation, nutrition and relaxation. No matter a hotel, restaurant, cafeteria or pub is being visited, they all offer a place to stay, food and drinks and some kind of surplus value. Albeit, the effect and emphasis can vary widely, based on the formula. Figure 4 shows the relevant innovation themes at the front office with an indication of the timeline and the size.

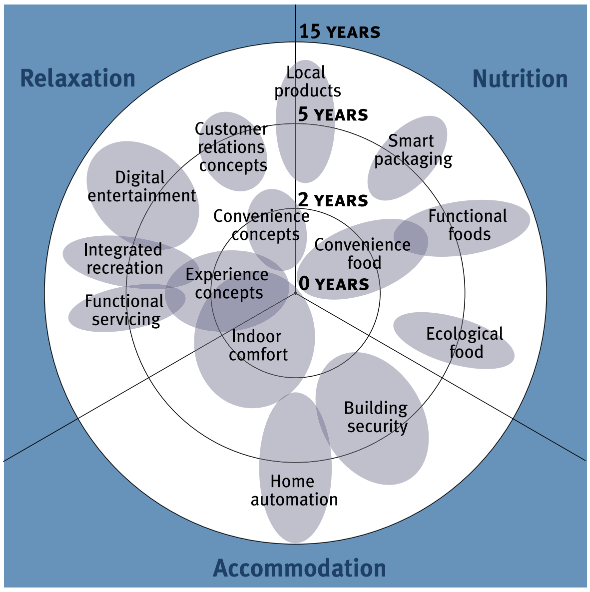


Figure 4: Innovation radar at the front office

Regarding accommodation, renewal is expected in the field of **customer safety** and **security**, and increasing comfort, which in the future will be increasingly automated. Nutrition shows a wider diversification for the client across the hospitality sector. Depending on the formula, image and target group a hospitality undertaker can go for more **convenience, healthiness**, local and/or **ecological food**. The customer can also expect more **smart packaging** to increase or communicate the food quality, food safety or convenience.

Relaxation within the hospitality sector develops towards a wide variety of experiences, going to more extremes, designed to a **specific function** and/or integrating several forms of recreation into one concept. Additionally, the convenience in the customers' leisure time is also increasing with several concepts and customer relations are developing into **a new era with ICT**. Finally, digital entertainment will be more widely available within the hospitality sector.

Innovation Radar Back Office

At the back office, the entrepreneur has to deal with the premises, business processes and a business concept. The premises refer to both - the building and its interior. The business concept is the general formula in location, price, quality and undertaking, while business processes refer to - the organisation of - daily activities. Figure 5 shows the relevant innovation themes at the back office with an indication of the timeline and the size.

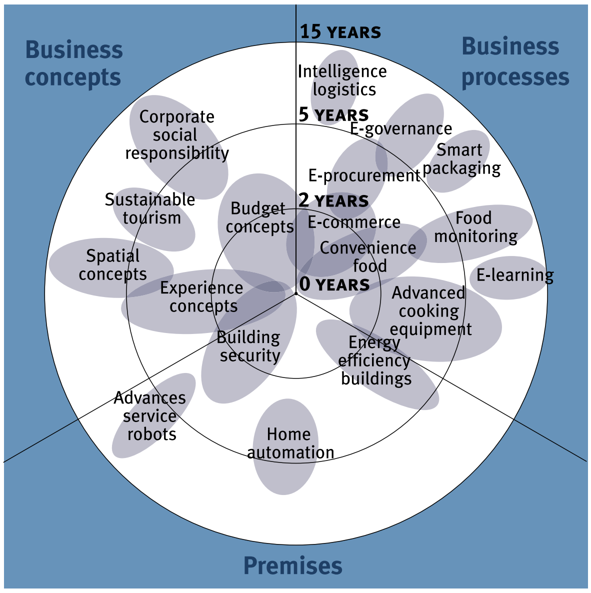


Figure 5: Innovation radar at the back office

Within the premises, the hospitality sector develops towards **more safety** and **security of employees**. While costs of energy and employees are cut by energy **efficiency, home automation** and advanced **service robots**.

Daily business processes will be enhanced in a wide variety of internal activities. Renewal in food preparation is concentrating on speeding up the **delivery time** and assuring **high quality with convenience food, advanced cooking equipment, food monitoring and smart packaging.** Marketing, education, logistics and administrative work are increasingly supported by **ICT** or, to be more concrete, by **e-commerce, e-procurement, intelligent logistics, e-government and e-learning.**

Business concepts will be more oriented on experience and/or on the short-term budget. Their surroundings and sustainability issues also increasingly affect formulas.

The Need to Focus on Mid-Term and Long-Term Innovation

The innovation themes and innovation areas identified give a broad overview of the major innovation trends within the hospitality sector. In terms of innovation, the hospitality sector shows a large overlap with the food industry and the recreation and tourism sector. On the whole, the hospitality sector is developing towards offering the consumer more convenience and safe and healthy food. The innovation themes of experience concepts, convenience food, and advanced cooking equipment have a major impact on change within the hospitality sector. This strong connection in terms of innovation with the food industry and the recreation and tourism industry calls for strong relations with those industries in order to accelerate and co-develop innovation.

Some innovation themes are underexposed and deserve more attention from the hospitality sector. Home automation, spatial concepts and advanced service robots are clearly blind spots. Their impact is underestimated while their time of influence is perceived too futuristic. This conclusion is quite generic: topical innovation themes are perceived as having the largest impact on the hospitality sector, while the impact of more medium and long term innovations are perceived as low. Considering the logical short-term view of business people, there is a task for a sectoral organisation like the Dutch Board for the Hotel and Catering Industry to look out for developments on the medium and long-term. At the time when those innovation themes become topical they can prepare the business people within the sector.

The overview of innovation themes and innovation areas also enables a further development of the innovation database. By searching top-down, several innovation concepts within innovation themes and innovation areas can be identified. In this way, the database can be filled up further with relevant innovation concepts. Possible focuses include the major innovation themes, which have the largest impact or adding blind spots like the non-occurring themes of home automation, spatial concepts and advanced service robots, which deserve some attention.

For the further development of innovation on a whole, a sectoral organisation like the Dutch Board for the Hotel and Catering Industry should focus on the level of innovation areas. This level corresponds to the strategic level of a sectoral organisation, on which projects can be initiated and/or knowledge can be transferred to business people within the hospitality sector.

Sources and References

The innovation platform of the Dutch hospitality sector can be found at www.horecainnovatie.nl (only in Dutch)

Central Macedonia 2018

Author	Tonia Damvakeraki/ damvakeraki@atlantisresearch.gr		
Sponsors:	Region of Central Macedonia		
Type:	Regional Foresight Exercise		
Organizer:	Region of Central Macedonia, Aristotle University of Thessaloniki, Logotech S.A.		
Duration:	2002-2004	Budget: € 375 000	Time horizon: 2018

Purpose

Regional authorities in Greece have little power in terms of making policy decisions and the central government is doing strategic planning for the whole country. The only instrument that can be used by regional authorities is the Regional Development Plan under the Community Support Frameworks. That was the main reason why the regional authorities in Central Macedonia decided to organise and implement a regional foresight exercise that would help them identify the most important priorities that need to be promoted under the forthcoming 4th Community Support Framework.

Need for Action at Regional Level

The region of Central Macedonia is the second largest urban area - the first one being Attica - of Greece. There is a high growth rate of the population and relatively high unemployment while the living standards are above the national average. As in most urban centers, Attica and Central Macedonia are the home of most decision-making centers. The most important industries and the mostly skilled and highly educated human resources are established in the region. The main issue in question for the region is the identification of ways to improve the quality of life, the socio-economic conditions, the decrease of unemployment, and the strategic development of policy measures for the promotion of R&D and innovation activities that will enhance the region's competitiveness.

The main policy instrument for facing these problems and challenges at regional level – as in Greece regional authorities have limited responsibilities in terms of strategic planning – is the Regional Development Plan. For this reason the Aristotle University of Thessaloniki proposed to implement a technology foresight exercise in Central Macedonia, for the strategic development and planning of the forthcoming Community Support Framework Programme (CSF). In close collaboration with the regional authorities the University of Thessaloniki set up the basic elements for the project, preparing a proposal for funding in the framework of Innovative Actions of the European Regional Development Fund. This was submitted to the European Commission by the region of Central Macedonia in May 2001, under the title "Excellence in Central Macedonia 2002-2003".

Under this scope, the Technology Foresight in Central Macedonia was initiated as an effort to identify the long-term trends for the development of specific thematic fields, with the aim to define priorities for the support of the regional innovation system and the amendment of the Regional Development Plan - under the 3rd CSF – as well as the development of the Regional Development Plan under the 4th CSF.

The foresight exercise was undertaken by the Research Committee of the University of Thessaloniki, which had already been involved in many activities of the regional innovation system. The coordination committee set as its goal "the identification of potential paths towards the development of the regional innovation system in Central Macedonia and the provision of information to all involved parties in order to choose the most promising one".

More than 70 scientists and researchers from the region collaborated closely for 18 months in the framework of this exercise. They examined the technological developments as a result of the scientific progress, assessing at the same time the effects in the citizens' everyday life.

The researchers constantly exchanged information and gave answers to the following questions:

- Which are the necessary technologies by 2018 for achieving the best possible results in terms of economic prosperity and competitiveness?

- Which are the major changes necessary in the innovation system that will contribute to this objective?
- How is the environment for these activities foreseen to change?

After the analysis of the strong and weak point, the opportunities and threats - SWOT analysis - that were implemented by the technical consultant (Logotech S.A.), **two horizontal issues** were set: **Human resources and South-eastern Europe** and its **economic development,** and **six thematic ones** that were considered as the most critical ones for the regional foresight in Central Macedonia:

- **Information technologies and telecommunications,**
- **Agro-biotechnologies,**
- **Environment,**
- **Energy,**
- **Transport,**
- **Materials, nanotechnologies, industrial technologies.**

Potential Users and Beneficiaries

The exercise was organised - as already mentioned – in order to identify and accordingly promote the main priorities for planning the future in the region of Central Macedonia. As regional authorities in Greece do not have policy making authorisation other than the Regional Development Plan (RDP), Central Macedonia authorities in collaboration with the local university decided to utilise foresight in order to develop and organise the forthcoming RDP based on the main research and technological priorities identified.

So, the main users of this exercise's results were the Regional authorities, the local University, the technology institutes and organisations established in the region - e.g. the Thessaloniki Science and Technology Park, the Business Incubator - the industrial and business associations as well as individual enterprises.

Skills and Competences from Past Foresight Experiences

This foresight exercise was the first one performed at regional level in Greece. The foresight experience in Greece is anyway limited so in order to organise the regional foresight exercise in Central Macedonia it was necessary to identify people with skills and competences that would promote the objectives of the exercise. For this reason, the experiences already gained by the National Foresight programme were brought in and similar methods and techniques were utilised for the implementation of the exercise. Many of the experts involved in the national programme were also invited to participate in the Central Macedonia Regional Foresight.

Some of the additional qualities and skills necessary for the exercise implementation were identified as soon as the specific areas / sectors were selected to be covered by the exercise. Through a call for expression of interest experts from these sectors were asked to participate in the thematic panels.

Communication throughout the Study

Communication was one of the most important issues when this exercise was designed. In order to achieve good communication between the thematic groups, the Steering Committee and all interested stakeholders met regularly, there were mailing lists and a working space on the project website and a newsletter with contributions and news from all thematic groups.

Keeping Participants Motivated

In order to keep participants both aware and motivated there were some efforts to advertise the exercise through the local papers and the web. This helped to emphasise the need – in terms of usefulness – for undertaking this exercise and the potential impacts and benefits that would be the outputs.

The stakeholders involved in the expert panels were chosen through a participatory approach - an open call for expressing interest - and as their involvement was volunteering, it was easy to keep them interested.

Only the members of the Steering Committee and the Chairpersons of the thematic panels were to participate in all working sessions while the participation of the rest of the panel members was more flexible.

Assessing Previous and Existing Work

The Technology Foresight Exercise in Central Macedonia was essentially the first to take place in Greece at regional level. The main studies / literature reviewed in the framework of the project were innovation strategy studies / policies implemented mainly at regional level.

Building Support

The regional authorities in Central Macedonia and the Aristotle University of Thessaloniki underlined their commitment for the elaboration of the exercise from the very beginning. They developed the methodological framework and hired an external technical consultant for the implementation of specific actions – i.e. the elaboration of the SWOT analysis for the future development of the regional policy. Furthermore, they organised workshops and information days inviting well known experts to present their work and experience in order to promote the foresight culture, which was pretty much unknown, especially at regional level. Finally, the formulation of the expert panels by selection of individuals, who expressed their interest in the open call that was published in the local press and the web.

Selecting Methods

As soon as the Research Committee of the Aristotle University started the exercise, the first action was to develop the necessary structure for the implementation of the exercise. The Coordination Committee was developed, consisting of the responsible person for science and a representative of the Research Committee of the University. The Research Committee of the Aristotle University of Thessaloniki provided resources and personnel for the development of a website for the exercise and its applications. Finally, a technical consultancy company was hired for assisting the exercise processes.

The technical consultant was responsible for the implementation of the SWOT analysis method and the identification of the main thematic and horizontal areas to be covered. The SWOT analysis also examined issues like: the role of regional foresight in Greece and the wider region of South Eastern Europe, **employment**, the size and structure of production in the **primary, secondary and tertiary sector**, the penetration of l**ocal enterprises in neighbouring countries**, the research potential, the **entrepreneurial potential**, the **investment in R&D** and the general strategic priorities in the Region as presented in the Regional Operational Plan for Central Macedonia in order to define the most important fields to be examined.

Based on the results of the SWOT analysis concerning the role of technology in each of the thematic fields, society, environment, economy and policy, a “basic text” was developed with a time horizon 2004-2018.

Based on the SWOT and the fundamental questions that were identified for each thematic field, the coordinators selected the main axis upon which the **Delphi** statements were developed. The use of the Delphi method was pre-determined by the call under the programme “Excellence in Central Macedonia”. Delphi is a knowledge acquisition tool. The six thematic panels proposed the statements. The technical consultant evaluated these statements and finalised eight Delphi questionnaires, which included 215 statements. The questionnaire was online and there were two rounds that were completed within two months time.

Identifying and Selecting Participants

For the selection of the participants and coordinators of the **thematic panels** there was an open invitation published in the local and national press in order to attract attention of relevant stakeholders. There were 120 candidatures mainly from the Aristotle University and the private sector.

The main criteria for the selection were:

- Broad knowledge of recent developments in the specific field,
- In depth knowledge of a sub-issue of the thematic field,
- Wide acceptance of the specific person by peers in the academic, research and industrial fields,
- Involvement in competitive R&D projects in the specific thematic field.

Tangible Outputs

The final report of the project gave a synthesis and a conclusion of the six thematic panels that were set up for discussing the various scenarios. The report included information about the current situation in these areas and the prospective developments for the time horizon set to 2018 for this exercise. There were also some suggestions in terms of policy measures for the region.

Intangible Outputs

As there were many stakeholders like the private sector, NGOs, professional associations, professional chambers, industrialists, consultants, researchers the interactivity and the synergies that were developed during the meetings / workshops of the expert panels were many and through them the thematic essays developed were of high quality. Networking between regional entrepreneurs and academia / research organisations were other intangible assets of the regional foresight exercise.

Promoting the Exercise

Making the people aware of the exercise communications was considered a vital element of the foresight exercise and the ‘promotion/marketing’ strategy was given a central place in the exercise both in terms of engaging policy-makers, stakeholders and the public.

The main tools used were:

- Information / awareness days
- The working space in the exercise website and the exchange of information and experiences through the online forum.

Positioning in the Policy Cycle

This exercise was initiated in order to pinpoint the most important research and scientific fields that are expected to play an important role in the development of the region until 2018. These areas were selected by the Research Committee of the Aristotle University of Thessaloniki and the technical consultant with the performance of a SWOT analysis of the region. The sic-thematic areas were discussed by specific panels that were formed after an open call that was published in the local press, in the framework of the scenarios that were developed in the National Foresight programme and also in the framework of two horizontal issues that were considered of major importance for the future development of the region.

The conclusions and suggestions that came out from the discussions of the thematic panels are meant to be used as a basis for the amendment of the Regional Development Plan under the 3rd Community Support Framework and the development of the new one - under the 4th Community Support Framework - by the regional authorities in Central Macedonia.

Disseminating Foresight Practice

In April 2003, an information day was organised in order to present the idea of the exercise, the types of methods that can be implemented and the potential results that may come out. Addressees were all stakeholders involved as well as the public. The information day was organised in the Aristotle University of Thessaloniki and there was an open invitation published in the media - local and national newspapers - for anyone interested to attend.

In this information day many experts in foresight, both from Greece and the EU were invited as speakers in order to explain the concept of a foresight exercise, to present specific cases and their results and indicate potential impacts of such an exercise at regional level. As this was the first exercise to be performed at regional level in Greece, this was a valuable introduction to the various foresight methods and their potential results.

Sources and References

http://foresight.rc.auth.gr

Ukrainian STI 2025

Author	Igor Yegorov/ yegorov@steps.ln.ua		
Sponsors:	Ministry for Education and Science		
Type:	National foresight exercise		
Organizer:	Ministry for Education and Science, National Academy of Sciences		
Duration:	2004 - 2006	Budget: € 85 000	Time horizon: 2020-2025

Purpose

The key objective of the Ukrainian national 'foresight-type' program is to form priorities in STI – Science, Technology and Innovation with long-term (15-20 years) and medium-term (3-5 years) perspectives and to determine the most promising areas for R+D, which could receive state financial support. The second main goal of the program is to create a background for a permanent system of state-sponsored foresight studies in the country.

Brief Historical Overview of Foresight Studies in Ukraine

'Foresight of S+T and innovation development' is a national program and was been approved by the Cabinet of Ministers of Ukraine in August 2004 but it started only in 2005, after the government provided financial resources.

Ukraine has a long history of foresight–type studies. The very first attempts to prepare normative forecasts of S+T and economic development in Ukraine could be associated with the establishment of the central-planning system. Since the late 1970s, the so–called Complex Programs of S+T Progress over the next 20 Years Period was started, along with the 'usual' five-year plans. These programs were oriented towards strategic issues and possible effects of S+T development, and not on short-term economic goals. At least 1500 key specialists from different research institutes took part in preparing the programs. The method of commission was used to reach consensus on different issues. In contrast with the five-year plans, it was possible to generate different scenarios within the program. This helped to understand better various outcomes and problems of the future. But 'the future' assumed the existence of the status quo in political and social spheres: the communist regime could not be changed and large-scale market reforms could not be introduced. These programs were parts of the similar All-Union program that had to co-ordinate development within the Soviet Union. At the end of the Soviet period, another 15-year forecast with special attention to the territorial deployment of productive forces and the distribution of R+D in different regions was introduced.

In the 1980s and early 1990s various ministries, the Academy of Sciences of Ukraine and even large companies in the military–industrial complex started to prepare their own long-term technological forecasts to define their technological policies. Some of them used Delphi-type procedures. The Cybernetics Institute of the Ukrainian Academy of Sciences developed methodologies of forecasting, and graph and computer software for these forecasts. Due to fundamental social and economic changes in the second half of the 1980s, almost all of these forecasts had no serious impact on development in Ukraine.

Between 1998 and 1999 the Cabinet of Ministries of Ukraine started to prepare the so-called 'Indicative Plan of S+T and Economic development until 2005'. The Ministry of S+T coordinated the preparation of this plan. The method of commission - with creation of several sub-commissions on different S+T spheres - was used. About 300 specialists were involved in the preparation of the Plan. Two joint sessions were organized at the end of the one-year project. After changes in the government, though, the draft of the plan was forgotten - despite being published and disseminated between different state ministries and agencies.

More Routine Required for Setting S+T Priorities

Every five years, the Ukrainian parliament establishes several main S+T priorities and the government starts dozens of technologically oriented programs. It is widely recognized that priorities are formulated in a very broad sense and the programs are not well designed and they have insufficient

financial resources to be undertaken. Time horizons of the specific programs and projects are usually short (1-3 years) and it is often unclear who the addressee of the results is and what the economic parameters of innovative products will be. That is why the government has decided to supplement existing mechanisms by the new foresight-type program.
In fact the program has four main tasks:

- To elaborate the basic and alternative variants of S+T and innovation development of the country,
- To form a list of the most prospective technologies and innovations, which will create opportunities for opening new external markets,
- To form a list of so-called critical technologies, which will have exceptional importance for the stable development of the national economy and for national security,
- To prepare recommendations for the Ukrainian government on how to use effectively R+D results, financed by the state, and to create the background for the permanent system of foresight-type studies in the country.

Experts Discussing New Technologies and Innovation

The Ministry for Education and Science (MES) of Ukraine is responsible for the distribution of money between participants of the program and its general logistics. The National Academy of Sciences of Ukraine is responsible for the content of the foresight studies.

Elements of the Delphi technique and commission method have been used in the program. In the first stage, the Scientific Council of the program was formed. It includes around 30 prominent Ukrainian scientists and top state officials. Two research institutes - one from the Academy and the second from the MES - were nominated representing the basic organizations, which were responsible for the technical side of the program's realization.

After broad consultations, fifteen thematic groups of scientists and other specialists were formed to discuss the following issues:

- Actual problems of state support of basic sciences and its infrastructure,
- Biotechnologies,
- Means and technologies for medical treatment of common diseases,
- Telecommunication, information technologies and resources; optical electronics and new computing technologies,
- Energy saving, non-traditional and renewable energy sources, problems of hydrogen energy utilization,
- Advanced technologies of agricultural production and the food industry,
- Technologies of metal welding and treatment of metals and alloys, new composite materials,
- Lasers and ionization technologies; nanotechnologies, functional and instrumental materials,
- Perspective chemical materials and technologies,
- Protection of environment and sustainable development,
- Macroeconomic drivers, demography and human potential,
- Applied aspects of earth sciences,
- Innovation in construction and architecture,
- Innovation in transportation systems,
- Space technologies and 'dual-use' technologies in the national economy.

Every group of experts consisted of 25-40 specialists from different research institutes, universities or leading industrial companies, usually from different cities of Ukraine. Special questionnaires were prepared and distributed among these experts in a two-stage Delphi procedure.

In the second stage, about 20% of experts were substituted by other specialists as a result of the analysis of the initial responses. The third round of survey is under way at the time of writing, and is planned to be finished between September and October 2006. The third round has to provide recommendations on how to improve the situation with S+T and innovation in Ukraine.

Every previous stage / round of Delphi was ended with special conferences and roundtables of experts and invited 'external' specialists, who discussed the key results of the program. Publications on the results of the studies were prepared and widely distributed among specialists within the country. In fact, everyone could express his or her opinion on the key findings of the program. It is worth mentioning that with the assistance of the British Council, British specialists with experience in Foresight programs took part in methodological seminars and conferences, which were organized within the program in 2005-2006.

Reduction of R+D Funding – Lack of Human Resources

The years of transition have demonstrated that the state had no sufficient material resources to preserve science in such conditions that it did over the years of the Soviet regime. Substantial reductions in R+D funding occurred during the period of market transformation, including cutting back on funds for financing new purchases of research equipment, while science was deprived of prestige and the status of scientists eroded.

These changes resulted in a gradual reduction in the number of researchers and a collapse of many branch – industrial - research institutes. Many scientists of middle age left their academic establishments and industry institutes and swapped their activities for more profitable ones, while others emigrated.

This has caused a deepening age gap between different groups of scientists, which was accompanied by the considerable shortage of 30-40 years old specialists - the most active part in terms of creative capacities. This age crisis in science will be hanging over Ukraine in the years to come. Alongside senior generations leaving active involvement in science, the shortage of skilled specialists will be more evident. By implementing urgent measures, the processes of age unbalance of personnel structure can be halted. However, the problem is complicated by the circumstance that it is very difficult to resume research activities after a break of several years because of the very specificity of this activity. In particular, measures undertaken by the government to increase payments to research fellows are inadequate for changing the situation radically, although they might make the crisis less acute.

Slackening of the Ukrainian Innovation System

The current low level of relative expenditure on S+T in Ukraine is incapable of supporting efficient research processes since funds barely suffice for paying relatively low wages and utility bills. Ukraine spends much less per researcher per year than EU countries, including new member-states, and even less than India or South Africa. Specialists who are involved in the foresight program suggest that the government as well as private sector could increase financial support for S+T, but any increases are unlikely to be enough to reach levels comparable to those of neighbouring Eastern European countries.

The national innovation system is weak, as the authorities do not pay serious attention to the stimulation of development of high-tech sectors. Creation of conditions for growth of high-tech enterprises is the key for the future of the national economy. If the government would establish any system, in which traditional sectors of the economy would not have artificial privileges, it would be possible to shift resources to innovations and R+D.

Strengthening the Traditional Research Areas

As to particular research areas, traditionally, Ukrainian scientists have relatively strong positions in material sciences, physics, and some technical disciplines. Here, Ukrainian experts look forward with restrained optimism. It seems that in some scientific fields S+T development will preserve dynamism and it is possible to expect interesting applied results, as, for example, in welding technologies. It is worth noting that problems of energy saving, utilization of alternative sources of energy and upgrading of the energy generating system have received the highest ratings for their importance. Bearing in mind existing potential and experience, there is a high chance that these problems will be studied and (partially) solved successfully.

The High-tech Divide

On the other hand, the gap between Ukraine and the developed countries in such areas as biotechnology, genetics, electronics, nanotechnologies, and health care methods will grow, despite these research areas having received high ratings for their importance from experts as well as Ukrainian scientists having promising results in some narrow sub-fields of these disciplines.

Interdisciplinary research, such as physical and chemical biology, sensors and environmental studies were mentioned as important directions of development.

Traditionally, Ukrainian experts have put much effort into research and technologies. But now and in the foreseeable future the country cannot conduct this research without engaging in intense international co-operation. The focus is being shifted towards practical aspects of the research, including observation of agriculture, telecommunications, and weather forecasts.

The development of the aviation industry, including the introduction of several new planes such as the AN-70 and modernisation of the AN-225, is under serious threat after worsening relations with Russia. At least several important joint projects have been halted and the prospects of other projects are not clear.

Need for Restructuring R+D Organisations

The Ukrainian foresight-type program shows that the country still has scientific potential in a number of areas. At the very least, Ukrainian specialists could provide qualified expertise of the importance of different research results and determine perspectives of S+T and innovation in key research areas. At the same time, it is evident that the country's research system continues to lag behind international standards of research, despite its world-class results in some research fields. S+T policy has to be better connected with the implementation of economic reforms. It is becoming critical for Ukraine under present conditions.

The most urgent objectives at the present stage of economic development are as follows:

- Development of better R+D organisation and enhancing R+D management, in particular, development of new organisational and economic forms of integration of science and production,
- Mastering of advanced management expertise by Ukrainian experts and their further dissemination nationwide,
- Improvement of industrial structure and acceleration of socio-economic development of the regions,
- Active implementation of R+D results and advanced technologies into different sectors of the national economy, and
- Further development of S+T co-operation with other countries, especially with the EU and neighbouring states.

There is no guarantee that the country could solve successfully a number of problems it faces at the moment, but the clear orientation on integration into the EU opens the way for effective modernization of the national S+T system and its utilization in the interests of Ukrainian society and the European Community.

Given today's economic conditions in Ukraine, the role of scientific and innovation activities are of growing importance. In particular, it is necessary to augment the role of scientific foresight in all areas of science, social growth and national economic development. Although foresight is an important 'scientific' instrument to make better-informed selections in the service of social and economic growth, it has been neglected for years. Now the urgent need for foresight studies is evident for a number of scientists, industrialists and officials. In particular, outlines and priorities of scientific research and economic policy, aimed at long-term economic growth, are to be identified by means of foresight. There are widely supported plans to conduct nation-wide foresight studies in Ukraine on a regular basis.

Sources and References

Foresight of S+T and Innovation Development of Ukraine (Preliminary variant).- Kiev, 2006, STEPS Centre, National Academy of Sciences of Ukraine, 160 p. (in Ukrainian, ISBN 966-651-307-2).

Russian Nanotechnology 2020

Author	Nadezhda Gaponenko/ foresightr@mail.ru
Sponsors:	Ministry of Science and Education of the Russian Federation
Type:	Sectoral National Foresight Program
Organizer:	RIEPL – The Russian Institute of Economy, Policy and Law. Contact Nadezhda Gaponenko - Head of Department of Foresight and Innovation Policy
Duration:	November to December 2005 / Budget: € 30 000 / Time horizon: 2015-2020

Purpose

The overall goal of the project was to develop a methodology for the NNFP or National Nanotechnology Foresight Program and to outline the global and national trends in nano-science and nanotechnology. Analytical studies were designed to feed the development of the Russian Nanotech Initiative and to provide inputs to Delphi-survey and scenario development processes.

Catching-up with Global 'Nano' Development

This project might be considered the first stage on the way to setting up the **NNFP or National Nanotech Foresight Program** in Russia. It can also be considered the analytical background for the Russian Nanotech Initiative. The point of departure was the recognition that Russia needed to assess its future from the global perspective, to identify strategic research areas for the next 15-20 years in order to support the competitiveness of the Russian economy and to respond to future social needs and to strengthen future-oriented cross-disciplinary activity inviting all stakeholders to discuss about the future challenges, benefits and threats.

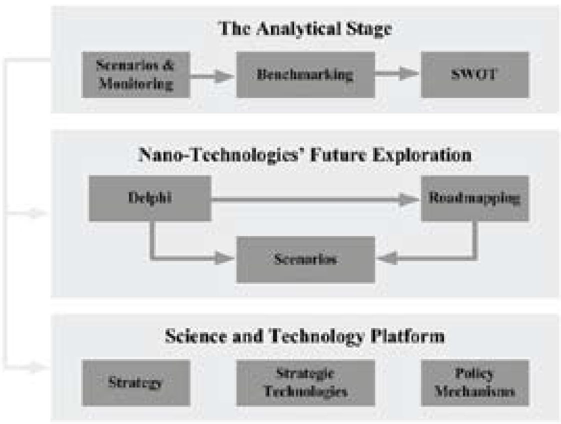
The project consisted of four parts:

- The methodological background for the development of the NNFP was the key objective of the project. The methodology was designed to provide a **dialogue between different stakeholders** and users of innovation to respond to the specific characteristics of nanotechnology. These were two key objectives of the methodological part of the project.
- The second part of the project was focused on the **global R+D trends** and on the analyses of the National Nanotech Initiatives around the world. The main task of this part of the project was to learn more from the experience of other countries.
- In the third part the future **nano-market trends** were outlined to provide the guidance for the public and private sector in terms of "What kind of niches of the world market are expected to flourish" and "What sectors of economy might be a significant consumers of nano-innovations in the future". Not only did the project focus on the macro-nano-domains – nano-materials, nano-electronic, nano-energy, nano-bio - but also on the future markets of the very precise nano-fields – nano-fibres, nano-powder, and the like.
- The fourth part of the project deals with Russian issues. The specific objectives of this part of the project were: to map Russian R+D capacity, to identify and to map Russian nanotech companies, to analyze governmental and private sector initiatives and to outline **strength and weakness of Russia** based on the points above.

Using 'Nano' Breakthroughs for Various Sectors of Russian Economy

Nanotechnology is an emerging, disruptive technology in an early and exploratory creative stage. This is a fast developing multidisciplinary S+T domain, which is expected to change all sectors of the economy, social needs and precondition the emergency of new markets. As a new emerging field its areas of application remain not well defined but it is already clear that the same scientific breakthroughs might be used in different sectors of the economy. The consequences - both beneficial and adverse - of technological innovations' implementation are not well explored; neither are the impacts of nanotech on other S+T domains. In addition, social values and cultural issues will have a special impact on nanotechnology development. The methodology was designed to meet these specific characteristics of nanotechnology.

The methodology was based on the combination of the following tools: scanning and monitoring - S&M, benchmarking, SWOT, Delphi, Scenarios, Technological Roadmapping.



S&M plays a special role for the analytical part and for the NNFP as a whole. It should be designed to feed the program and to provide inputs to all methods and tools. Based on this assumption the general and specific indicators for the S&M were formulated in the project.

Delphi plays a key role for the exploration and assessment of coming technologies. Its methodology comprises the inclusion of the corporations, academia, governmental officials and innovations' users given the fact that cultural and social issues are of considerable importance to the nanotechnology evolution. These four groups of actors have different knowledge and interests concerning the future of nanotech. Accordingly, it was concluded to develop four questionnaires with common technological statements but different characteristics / indicators.

Designing Questionnaires for Each Target Group

The task of **academic researchers** is to evaluate the nanotechnology impact on the development of other S+T domains, their possible negative impact on population health and environment, to outline the likely scientific and technical barriers and to suggest S+T policy mechanisms as well as to estimate the gap - forestalling or tardiness - of Russian R+D in compression to the world leaders. It was purposed that **corporations** should evaluate market demand and barriers, fields of nanotechnology application and the impact of nanotech on the competitiveness of Russian companies as well as to formulate innovation policy mechanisms. The role of **governmental officials** was to estimate public demand, institutional and legislative barriers and to suggest policy mechanisms. At last **potential users** should evaluate future technology in terms of cultural barriers and their importance for the solution of social and environmental issues. This approach provides opportunity to make a comprehensive assessment of nanotech, to accumulate knowledge of different stakeholders and potential users and to link science push and demand pull approaches.

Exchange of Information among Stakeholders

Since nanotechnology is an interdisciplinary and fast developing domain it was decided to couple Delphi with a multidisciplinary brainstorming workshop to outline what kind of scientific breakthroughs with significant impact on economy and social problems' solution could happen in the future. It is expected that this workshop's outputs could serve as one of important inputs to the Delphi questionnaire.

Delphi was developed to provide the dialogue between different stakeholders. For this purposes it was suggested in the second round to send the output of the first round calculated for each group of respondents to the members of four respondents' group. This way each group of respondents could learn the expectations of other groups. Corporations, for example, could learn the expectations of innovations' users, governmental officials and scholars and make corrections in their own judgments.

Developing the Nano Roadmap

Delphi outputs were proposed to be used for the first round of technology prioritization. For this purposes the methodology suggests using the following approaches:

- Orientation on the consensus between different respondent's groups,
- Realization of four stages of technology mapping using the criteria of technology importance (in terms of competitiveness at the world market, contribution to the social and environmental issues solution, impact on the other S+T domains' evolution and importance for the national defence sector) and likelihood,
- Evaluation of possibility of technology implementation in different sectors of economy.

Delphi-survey outputs serve also as the input for the development of **technological roadmaps**. Roadmaps were built for different nano-fields – nano-materials, nano-bio, nano-electronic, nano-energy. It is expected that they will be used by policy-makers and scholars and serve as input for the S+T platform development. The roadmap for different sectors of economy is oriented towards the implementation by corporations and as input for scenarios.

Scenarios: Putting the Building Blocks Together

Scenarios play a special role for the NNFP. They help to explore how nanotech will be perceived in different contexts – geopolitical, economic, social and cultural. The scenario approach is used for fostering a dialogue between different stakeholders. It is considered a powerful tool for the learning process. Information from all building blocks of the NNFP -

S&M, benchmarking, SWOT, Delphi and technological roadmaps - is used as input for scenario building.

Special characteristics of the nano-scenario approach were:

- Implementation technological roadmaps - technologies are used as events in scenarios,
- Evaluation of external environment impact on the technological trajectory and adverse impact of technological development on the external environment,
- Delineation of turning points in technological trajectory,
- Analysis of critical uncertainties.

THE SCIENCE AND TECHNOLOGY PLATFORM	
COURSES	METHODS and TOOLS
Normative Scenarios	Goal Tree Stakeholder Workshops
Benchmarking SWOT and Scenarios	Morphological Analys Stakeholder Workshops
Delphi & Scenarios Technology Roadmaps	Stakeholders Workshops
Delphi & Scenarios	Stakeholders Workshops

The outputs of analytical and future studies serve as inputs for the development of the national S+T platform. Fig.2. gives an idea about information sources and methods & tools used for these purposes. The design of NNFP as a dialogue forms also the framework for possible networks and for public-private partnership.

Predominance of Nano-materials in the Russian Nano-sector

The project might be considered the first study providing the mapping of Russian R+D capacity and nano-companies, evaluating public and private sectors' initiatives and challenges.

Sectoral and Regional Concentration

Within the Russian R+D system the project identified 147 R+D organizations in the nano-field, thereby outpacing Asia and North America (see Table 1 below) although some experts understand that some R+D organizations of defence and energy sectors as well as some small research centres were missed due to lack of information. The strong predominance of academic institutes (40%) and universities (30%) is observed as well as their concentration in the Moscow area (more than 50%). The most part of R+D organizations perform in the field of nano-materials (72%) and nano-electronic (18%).

Funding Organisations

Russian nano-science is financed from different sources. The Ministry of Science and Education (MSE), the Ministry of Industry and Energy, Ministry of Defence, the Ministry of Public Health, the Russian Academy of Sciences, the Russian Academy of Medical Sciences, and the Russian Foundation of Fundamental Research (RFFR) are the key agencies supporting nano-science. It has to be pointed out that the Ministry of Science and Education plays a special role in supporting civilian R+D of RFFR. It was evaluated that, in 2005, the budget appropriations for nano-science was about $US 220-250 mill. Therefore Russian public investments into nano-science are less than those of the USA, Japan and EU but higher than public investments of many Asia-Pacific and EU countries.

R+D projects are supported in various national and departmental programs: "National Technological Base" (2002-2006); "Ultra-dispersion Nano-materials and Nanotechnologies"; "Nano-electronic of Armed Forces of the RF till 2010"; "Development of R+D Capacity of High School" (2006-2008); "Low-dimensional Quantum Structures"; "Nano-materials and Supra-molecular Systems"; "Physics of Solid Nanostructures"; "R+D in Priority Directions of S+T (critical technologies)".

More Coordination among Agencies Needed

Some regional authorities - in particular in Moscow and Tomsk – also support nano-science as part of regional and municipal programs. However R+D is not coordinated between different departments and federal and regional power structures. One may observe duplication of R+D on the one part, and lack of information about the outputs, on another part. An Interdepartmental Council on Nano-science and Nano-materials was set up however the coordination of activities still remains a problem.

In 2005 MSE gave special attention to the development of scientific and information infrastructure in the nano-field. There are 36 centres in the Russian Federation where research facilities might be used by public and private sectors - much more than in other countries. In 2005 MSE allocated about €24 million for the purchase of equipment for the centres, however one may observe low demand from management of both public and private sectors for the development of these facilities.

Russia's Weakness: Commercialization

At the beginning of 2006 a National Program of Nano-science Development was launched to focus on resources and to coordinate the upcoming challenges. This program will run till 2015.

On the Russian market the project identified 20 nano-companies – about 80% of them played on the nano-material's market. All companies were classified as SMEs.

Most of these were spin-offs. It is assumed that some companies do not represent themselves as 'nano'. Comparing Russia to other countries one observes that Russia is rather strong in terms of R+D capacity but dramatically weak in R+D commercialisation and in the setting up new start-up companies (see Table 1).

Companies in the Market				
Region	Large	Affiliates	SMEs	R+D Orgs
Asia	50	22	51	111
EU	26	2	125	170
North America	41	41	278	107
Russia	N.A.	N.A.	20	142

There are many factors responsible for this situation including historical and cultural ones; however, unequal governmental measures seem to take major responsibility:

- There were no measures to support spin-offs and start-up companies,
- There was a lack of activities to support networks and academia-industry relationships.

The Russian innovation system remains fragmented. There is limited mobility between research institutes and between R+D system and industry. Russian R+D organizations do not have many traditions in the commercialization of research results or in the handling of patents and other IPR issues. The Russian innovation system also suffers from a weak entrepreneurial tradition.

Focus on Comparative Advantage

Nanotechnologies can be regarded as a challenge to foresight methodology, as well as to the economy, R+D and educational systems and to the public at large. The general messages that have come out from the project are that methodology should respond to special characteristics of nanotech, and NNFP should be designed as a dialogue between different stakeholders. Russia should focus on the areas where it has comparative advantages. Further the experts recommended that the Russian Federation should concentrate its resources on specific sectors and sub-sectors, and coordinate its activities between different departments, foster public-private partnerships and strategic thinking.

The main recommendations made to policy-makers were the following:

- To develop measures to support spin-offs and start-ups,
- To support multidisciplinary networks, research teams and institutes as well as academia-industry partnership,
- To set up websites providing researchers and industry with information in nanotechnology and related fields - markets, patents, completed R+D, and the like,
- To support interdisciplinary training and education.

Sources and References

This monograph was prepared on the basis of the 'Nanotechnology Foresight' project by Nadezhda Gaponenko. The final report of the project will eventually be made available on the web.

SCOPE 2015 - Scenarios for EU RTDI Cooperation with Developing Countries

Author	Michael Keenan/ Michael.Keenan@manchester.ac.uk		
Sponsors:	European Commission		
Type:	Pilot foresight exercise		
Organizer:	PREST of the University of Manchester		
Duration:	2005-2005	Budget: € 100 000	Time horizon: 2015

Purpose

The SCOPE 2015 Project, which was conducted during 2005, sought to demonstrate the utility of foresight to EC policy makers and others concerned with RTDI cooperation with developing countries. The project was small in scale but big in ambition, covering four regions of the world: countries of the Commonwealth of Independent States the CIS states excluding Russia, Latin America excluding Brazil, Maghreb and Mashreq, and Sub-Saharan Africa excluding South Africa. The specific purpose of the project was to produce ten-year scenarios focused upon contextualised scientific and technological developments in selected regions of developing countries with a view to drawing implications for European RTDI cooperation policy. The project was led by PREST of the University of Manchester in cooperation with three partners: CKA of Belgium, the Malta Council for Science and Technology, and the Steinbeis-Europa Zentrum in Germany.

Europe Has a Long History of International RTDI Cooperation . . .

For more than 20 years, the European Union (EU) has been supporting research cooperation with countries in all parts of the world, the objective being to promote sustainable development and research, technological development and innovation (RTDI) partnerships. This cooperation has been implemented through comprehensive International S&T Cooperation programmes (INCO) within the framework of EU research activities.

The EC's INCO Unit already has processes in place in which it has been considering options for how international cooperation might be enhanced in FP7 – the Seventh Framework Programme. SCOPE 2015 was careful not to reproduce these processes but instead to establish a complementary process that looked farther out to FP8 and the year 2015 in order to consider a variety of visions or scenarios for what international RTDI cooperation might look like. The process of thinking about these contrasting scenarios of the future was intended to encourage policy-makers to examine the long-term implications of the decisions being taken today and, if necessary, to change policy directions to achieve more desirable outcomes. In other words, despite the ten-year time horizon of the project, it was supposed to have implications for policy decisions and actions taken today and in the near-future.

The specific focus of SCOPE 2015 was upon RTDI cooperation with 'developing countries' only a part of EU international RTDI cooperation coverage. Four regions were covered, namely the Commonwealth of Independent States (CIS), Sub-Saharan Africa (SSA), Maghreb and Mashreq (MEDA), and Latin America (LA). Not all countries in these four regions would normally be described as "developing countries", but the label was used to distinguish SCOPE 2015 from a sister project that focused upon the "emerging" BRICS economies (Brazil, Russia, India, China, and South Africa). All four regions are important strategic partners for the EU for a variety of different reasons, such as trade, investment, protection of habitats and the global environment, international security, migration, and so on. In turn, RTDI can make important contributions to all of these policy areas.

In this short brief, the SCOPE 2015 methodology is briefly presented, along with some of the main findings of the project. There is insufficient space to describe findings for each individual region – the reader should consult the SCOPE 2015 web site for this information.

Defining the Contours of the Project

The fact that there is no single body analogous to the EU in these four regions meant the project had to focus upon the national level for its RTDI data. Due to the relatively short duration of the project and its modest budget, just 3-4 countries in each region could be covered in detail (see Box 1). Whilst attempts were made to achieve a representative cross-section of countries, it was sometimes difficult to do justice to the full variety in the regions.

Box 1: Countries covered in SCOPE 2015

CIS	LA	MEDA	SSA
Azerbaijan Georgia Kazakhstan Ukraine	Argentina Chile Colombia Venezuela	Jordan Morocco Tunisia	Botswana Ghana Kenya Nigeria

The broad scope of the project and its limited resources also meant it was impossible to identify specific RTDI areas where the EU should focus its cooperation efforts (other than in a general way). Instead, the project concentrated upon those dynamics associated with the framework conditions for RTDI activities in the regions. Accordingly, the main focus was upon trends and drivers that are internal and external to the national RTDI systems in the regions and the implications these might have for RTDI cooperation with the EU:

- Internal trends included things like national RTDI spending patterns, the use of science by national socio-economic actors, such as governments and industry, institutional and policy reform programmes, and so on.
- External trends included things like the internationalisation of skilled labour markets, aid donor strategies and the activities of trans-national corporations.

Scenarios - The Core Methodology

The uncertainty, yet importance, of these sorts of trends and drivers made a scenario approach particularly suitable when thinking about the framework conditions for future RTDI cooperation. However, before scenarios could be constructed, background data on the regions and their existing RTDI collaboration had to be gathered. In other words, to understand and build for the future requires an appreciation of developments and dynamics in the past and the present. Moreover, an important principle of EU RTDI cooperation is that it should be founded on active and constant dialogue with partner countries and regions, and sensitive to the socio-cultural approach of each partner country.

This was the starting point for the SCOPE 2015 process (see Figure 1), which began with the appointment of appropriate science policy experts as National Correspondents in the fifteen selected countries, each of whom was tasked with providing a **Country Report**. These Reports provided a dynamic picture of past and current developments in national RTDI systems and were validated by other national experts in each country through a web-based discussion forum.

Figure 1: Overview of the methodology

After validation, the Country Reports were synthesized and collated into four **Regional Synthesis Reports**, which sought to draw out the main trends and drivers at work in each of the four regions and to speculate on their possible future trajectories. The latter were articulated as sets of **ten-year forecasts**, which were discussed and debated among National Correspondents through teleconference consultations. In the wake of these consultations, three **baseline scenarios** were generated for each region. The aim was to expand the "possibility space" for RTDI-related developments over the coming decade by articulating distinct and contrasting future visions and "future histories" in each of the scenarios. None of the scenarios were intended to be predictions of the future. Instead, they were suggestive of the ways in which future developments might unfold and attempted to highlight the links between current and near-future policies and longer-term consequences.

The scenarios were the main input into a **Scenario Workshop** organised in Brussels in June 2005, where all National Correspondents were brought together with EC officials and others with an interest in RTDI cooperation for development issues. The aims of the Scenario Workshop were to generate a **"Success Scenario"** for RTDI cooperation between the EU and each of the four regions and to identify a set of concrete **action points** (see Figure 2). The results of this Scenario Workshop were later presented and discussed at a **Policy Forum** in Brussels in November 2005, and a number of practical actions suggested.

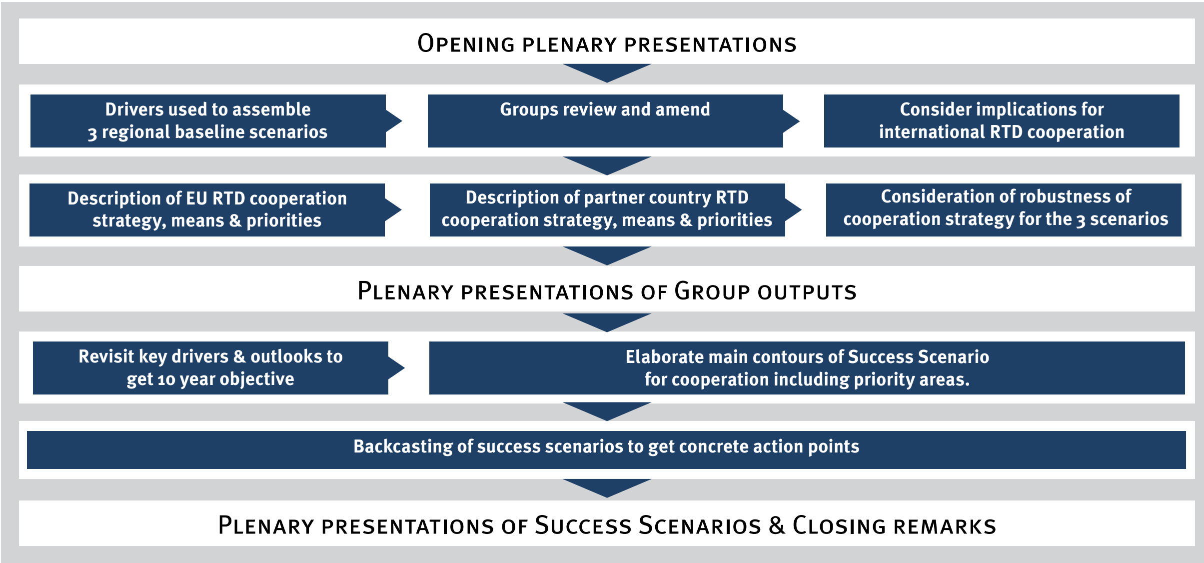


Figure 2: Overview of the Success Scenario Approach

Many Trends and Issues are a Major Source of Concern

An initial concern of the project team was that the four regions under study are all very different and that this would make bringing them together into a single project of this modest scale problematic. Whilst there are a number of regional specificities that must be considered, it was nevertheless rather surprising to discover the scale of commonality:

- All regions suffer from chronic under-investment in RTDI. Whilst it is difficult to assign an appropriate target for research funding in developing countries, the levels of spending in many areas have actually fallen over the last two decades, leading to the deterioration of infrastructures and the loss of human resources. Funding regimes are rarely transparent and prefer, for the most part, to distribute resources through institutional block grants rather than competitive calls for research proposals.
- The so-called brain drain is of serious concern in all regions covered in the project. Whilst new thinking on mobility talks of brain circulation, the simple fact is that many countries covered by the project have few opportunities available for returning researchers. Mobility is therefore almost entirely in one direction towards the West and to the detriment of the regions, at least for the time being.
- To varying degrees, in many countries, RTDI institutions and governance are weakly developed and/or in need of reform. Institutional regimes tend to be modelled along traditional lines that see the academy (whether in the form of universities or other academic institutions) separated from the worlds of policy and business. This separation acts as a barrier to linking RTDI to real world socio-economic problems. It means that national systems of innovation fail to function in most countries across the four regions.
- At the same time, the private sector is disinclined to conduct its own research. Moreover, most indigenous firms show little interest in engaging with the science base and instead prefer to source their technology off-the-shelf from abroad. The linkage of local science to innovation therefore remains weak.
- For most countries in the four regions, capacities tend to be minimal or are non-existent in new technologies such as nanotechnology. This raises the prospect of an ever-widening technological divide between the countries in these regions and the OECD countries.
- Common problems and challenges, particularly around the natural environment and the sustainable and efficient use of resources, loom large across all regions. Yet, the full potential of RTDI to contribute to the solving of these problems is rarely realised.
- There is an enthusiasm across the four regions for further collaboration with scientists in the EU, but a general lack of awareness of available opportunities, coupled with the bewildering complexity of the Framework Programme, have made cooperation difficult. The EC is well aware of many of the problems here, but the message from the scientists in the regions is that more needs to be done in FP7 to address them.
- To a varying degree, there is in all regions considerable interest in increasing RTDI linkages between countries within the regions. This is most pronounced in SSA and LA, where models similar to the European Research Area were proposed during the course of the project.

Recommendations for Action

Box 2: Generic Recommendations made to the EC in light of the SCOPE 2015 Success Scenarios	
1.	Transferring the ERA concept to other regions through the establishment of regional research areas in places such as Latin America and Sub-Saharan Africa
2.	Furthering coordination on cooperation policies and programmes among the General Directorates of the EC, and between the EC and the national agencies of the Member States
3.	Ensuring a balanced portfolio of measures and programmes that support a range of cooperation activities
4.	Mainstreaming 'knowledge policies' i.e. introducing RTDI policies into all areas of the EC's international cooperation activities
5.	Promoting re-organisation of national research systems around interdisciplinary problem-focused centers of excellence through incentives and policy transfer
6.	Supporting entrepreneurship and start-ups within the framework of a coherent national/regional innovation strategy that is relevant to socio-economic needs
7.	Actively managing mobility of researchers and students to build local capacities and to minimize the occurrence of damaging brain drains
8.	Enhancing information flows about RTDI cooperation opportunities to researchers in both third countries and EU Member States
9.	Raising awareness of the crucial role of RTDI policy for development and building local capacities to develop and deliver sound and effective policies
10.	Conducting further foresight-type exercises to examine the opportunities and threats associated with a myriad of issues concerning RTDI developments

Given this commonality, it was possible to make wide-ranging generic recommendations to the EC for the improvement of RTDI framing conditions in the four regions (see Box 2). These action points are meant to be additional to the reform agendas that need to be adopted by national governments in the four regions. In fact, many are complementary or even catalytic to such reform agendas.

Without paying sufficient attention to the framework conditions for RTDI activities in the four regions – the main focus of SCOPE 2015 – there is a real danger that little RTDI capacity will remain in some countries, reducing the scope for future cooperation with Europe. The ambitious objectives of this modest project were to highlight these dangers and to offer alternative visions of more desirable futures. Only time will tell whether warnings have been heeded and opportunities seized.

Sources and References

Further information can be found on the SCOPE 2015 website at http://les.man.ac.uk/prest/scope

Technology for Industry Foresight - Kocaeli 2012

Author	Ozcan Saritas/ Ozcan.Saritas@manchester.ac.uk		
Sponsors:	Gebze High Technology Institute & Kocaeli Chamber of Industry		
Type:	A Regional Foresight exercise for the industry located in Kocaeli		
Organizer:	Gebze High Technology Institute Kocaeli Chamber of Industry		
Duration:	2001-2002	Budget: None allocated	Time horizon: 10 years

Purpose

Kocaeli is one of the leading industrial cities in Turkey. Technology Foresight exercise for industry in Kocaeli aimed at shaping the future of the region through university-industry collaboration by anticipating changes, developments and advancements in manufacturing technologies and increasing the effectiveness and competitiveness of the industry in the region.

Foresight for an Advanced Technology-based Industry

Kocaeli is a heavily industrial city located in the north-west quarter of Turkey, right next to Istanbul, which is the financial capital of the country. Hosting most of the leading industries of the economy including chemicals, automotive, petroleum and electronics, Kocaeli has 12% share in the total production of manufacturing industry in Turkey. Considering the foreign trade volume, Kocaeli's share is 11% of total exports of the country. As a result of these high production figures, Kocaeli achieves nearly US$10,000 Gross Domestic Product per capita and thus is one of the highest wealth-creating cities in Turkey.

However, research on the technology and R&D intensity of the industry in the region indicated that only 30% of the Kocaeli industry used advanced technology, which was obtained mainly through know-how and licensing. The proportion of R&D expenditures in the total revenues of companies amounted 0.6% in average. Moreover, the proportion of the number of R&D personnel to total number of employees in companies was below 1%.

In spite of the economic success, these negative indicators in manufacturing sectors pushed the industrialists and academics in the region to think about the long-term future in order to develop new investment and production models to increase the competitiveness of the industry and to raise industrial value-added.

The idea of initiating a Foresight exercise in Kocaeli came to the agenda with the proposal of the Gebze High Technology Institute (GYTE) and the positive response of Kocaeli Chamber of Industry (KSO) in April 2001.

Following the meeting of GYTE Senate in June 2001, a working group was established at GYTE. The group was responsible to conduct the Foresight exercise and to produce final reports in cooperation with KSO.

The exercise started in September 2001 and ended in November 2002. There was no budget allocated for this exercise.

Assessing Socio-economic Issues and Technology Trends in the Region

Following the clarification of the rationales of the Foresight programme, common foresight methods and experiences of other countries were reviewed and presented to the participants in the first meeting of the exercise in July 2001.

The methodology designed and the methods used were inspired by the practices of other countries. In order to identify the expectations of the industry and the future developments in technology, a combination of brainstorming, survey/interview, SWOT and Delphi techniques were used.

Thus, the methodology designed for all sectors included four phases:

PHASE I: The identification of areas of investigation for each sector through the:

- Identification of global and national mega trends
- Detection of trends, issues and drivers
- Discussion on socio-economic issues related to that particular sector such as increasing population, the education level of the population, economic conditions and entry to the EU
- Discussion on technology-related issues such as the developments in transportation, communication and manufacturing technologies, the requirements and expectations of customers, the attitude of employees against technical and technologic developments
- Identification of the critical technology areas

PHASE II: SWOT analysis for each of the following points:

- The state of the manufacturing resources including employment and production; human resource; physical resources; information sources; capital sources; infrastructure; relationships with suppliers
- The state of demand including sales, customers and distributors
- The structure and intensity of competition: fundamental areas of competition; technology and manufacturing; distribution and marketing; specialisation and managerial skills

PHASE III: The identification of future technologic and scientific inventions, developments and advancements; and the discussion of their potential importance and impacts by considering:

- The technology areas to be investigated
- The technologies to be focused on production activities
- The necessity of product, process and service innovation required in the technology areas identified
- The focus and format of R&D activities

PHASE IV: A Delphi survey for the assessment of technological developments and advancements through the following questions:

- The degree of the social and economic benefits
- Time of realisation
- Steps of realisation
- Turkey's competitiveness versus other countries
- The obstacles for realisation
- Proposals and comments on the technological developments and advancements

Academia and Industry Take the Lead for the Future of Kocaeli

The project team established for the technology foresight exercise consisted of 73 members including 38 academicians, who were mainly from GYTE, and 35 top-level managers and businessmen from the region. 10 members of the Project Team, including the President of GYTE and the President of KSO, constituted the Steering Committee. The members of each working group were identified by considering the equal representation of academia and industry. The working groups met once a month. They applied the designed methodology described above.

High-technology and Skilled Labour to Modernize Manufacturing Technologies

In the second meeting of the technology foresight exercise in September 2001, current social, technological and economic conditions of the region were discussed; main issues were identified; and expectations from the future were clarified. Based on this work, one of the most important outcomes of the meeting was the establishment of 11 working groups, which were named with corresponding sectors and themes, including:

- Societal and economic needs
- Environment
- Energy
- Advanced Materials and Nanotechnology
- Electric and Electronics
- Information and Communication Technologies and Media
- Chemicals
- Biotechnology, Genetics and Health
- Food
- Machinery and Automation
- Automotive and Transportation

The findings of each working group were brought together in 11 reports, which were authored by the chairs and reporters of each group.

Some of the noteworthy areas of investigation raised by the working groups include:

Manufacturing technologies: Introduction of *"rapid manufacturing systems"* was seen as a must for the industry. The most important shortage in Kocaeli (and in Turkey in general) was seen as the lack of qualified workforce. It was foreseen that this issue will be more crucial by 2007. The use of CAD/CAM programs were seen also crucial. Although Turkey's current position of using these programs was seen comparable to other developed countries, it was considered that development of CAD/CAM software in line with the requirements of the industry in Kocaeli would be important in the next five years.

Nano-materials: Surface technologies and nanotechnologies were seen potentially beneficial for the manufacturing industry in Kocaeli. Instead of changing the characteristics of the complete structure of the material, the technologies, which would help to modify only the surface of the material, such as filming, would revolutionise the manufacturing process and products by preventing deterioration and corrosion of mould and manufactured product in a significantly economic way.

Energy production and use: Three points were seen important for the production and use of energy:

- *The security of supply:* to make sure that the risks on the society and industry in terms of energy supply is minimised
- *Openness to competition:* in order to provide low cost energy for producers and consumers
- *Environmental protection:* to ensure the protection of the ecologic and geo-physic balance of the nature in the production and use of energy.

Food production and storage: Some of the remarkable technologies identified as important for the industry included:

- *Halogen heating systems:* The food will be heated up faster than current microwave technologies by preserving its quality, colour and taste better
- *E-nose:* This electronic nose will be used when it is risky or impossible to analyse the quality of food by smelling.
- *Smart packaging:* Through these technologies it will be possible to process foods minimally. Smart packages will breathe and thus will provide the best conditions for the protection of foods.

Concerted Efforts of All Actors Required

The technology foresight exercise for Kocaeli industry concluded that for the application of these and other advanced technologies necessary conditions should be created at the following points through collaborative actions between national and regional governments, academia and industry:

- **Education and employment:** The industry needs skilled labour force immediately. It is suggested that the number of schools delivering technical and vocational training should be increased with appropriate curriculum. The possibility of bringing skilled labour force outside the region is seen as one of the quickest solutions for this problem in the short term
- **Infrastructure:** Particularly as a result of the destructive earthquake in 1999 some infrastructural problems emerged in the region. Therefore, it is suggested that investments should be done for the improvement of basic infrastructure such as energy, transportation and communication.
- **R&D support:** The amount of R&D support should be encouraging enough for the industry to initiate such activities. The ties between the university, industry and national government are considered to be strong enough for the creation and mobilisation of funds.
- **Competitiveness and support:** The economic problems in past years damaged the demand and competitiveness of the industry. It is suggested that the firms, especially the exporting ones, should be supported by easing the bureaucratic process of transferring funds and credits. Reduction in taxes is seen another measure to be taken by the national government.

Model for a 'Techno-City'

Technology foresight for Kocaeli industry was one of the first regional Foresight initiatives in Turkey. The project produced a number of innovative ideas and projects, which were then disseminated widely in the region for the realisation of the region's future vision.

Being the first of its kind, the exercise was expected to contribute to the technology development progress of Turkey. The exercise provided a very important input to the creation of 'Turkish National System of Innovation', which was given weight in the Eighth National Development Plan covering the term between 2000 and 2005. While the process of the establishment of legal frameworks for 'Organised Industrial Zones, a 'Techno-park', 'Technology Zones' and 'Industrial Zones' was ongoing at the national level, Kocaeli had already taken the lead and had indicated a model of 'Techno-City' in Turkey.

The technology foresight exercise created valuable networking opportunities between the academics and industrialists in the region. Although the academics were aware of the present and potentially useful new future technologies, they did not know much about the industry in Kocaeli. Meanwhile, the industrialists in Kocaeli were well aware of the current production technologies and they did not sufficiently know the technologies, which would constitute the dynamics of the manufacturing in the future. Thus, the biggest outcome of the exercise was that it facilitated the mutual recognition between the academia and industry in Kocaeli and created a future-oriented knowledge sharing platform between them. As a result the exercise exhibited a very explicit example of the desired collaboration between the academia and industry.

Although the Foresight exercise in Kocaeli was not without any problems as many other foresight exercises due to such as the lack of experience, the reluctance of corporations to share the information, and limited participation to the Delphi survey; it was, however, an invaluable experience for the region, where there is a consensus on the continuity of the Foresight activities.

Technology foresight exercise for Kocaeli industry created inspiration for other cities in Turkey and encouraged them to think long-term at the regional and local levels. Such vision building activities have been carried out in the other cities in Turkey. One example – 'Trademark city Gaziantep' started in 2003.

Sources and References

- Gebze High Technology Institute and Kocaeli Chamber of Industry (2002). **"Technology Foresight for Kocaeli Industry"**, final report of the Technology Foresight exercise, Gebze.
- Kocaeli Chamber of Industry web site: **http://www.kosano.org.tr/**
- Trademark city Gaziantep web site: **http://www.trademarkcity.org/**

German Delphi on Corporate Foresight

Author	Jan Oliver Schwarz/mail@joschwarz.com		
Sponsors:	Institut for Futures Research at the Graduate School of Business, University of Stellenbosch, South Africa		
Type:	National foresight exercise		
Organizer:	Jan Oliver Schwarz		
Duration:	2005-2006	Budget: n. a.	Time horizon: 0.5 years

Purpose

There is evidence that a growing numbers of corporations in Germany are engaging in foresight activities. What seems to be of interest is how corporate foresight will evolve in the future in German companies. This brief reflects on a Delphi study which was carried out in response to the question what corporate foresight hereafter might look like in the field of management and how it can be deter¬mined what potential corporate foresight might have in German companies. Besides assessing the future of corporate foresight the aim of the Delphi study was to assess the status quo of foresight in German companies.

The Urge for Corporate Foresight

While it can be argued that the term 'foresight' is being used increasingly since the 1980s, corporate foresight is not such a recent development. Burmeister et al. (2004) argue that corporate foresight can be perceived as futures studies in corporations. After the original evolvement of futures studies in the 1950s, primarily in the governmental field, futures studies are now experiencing a growing importance in corporations. In particular corporate foresight seems to be on the rise, most popularly proclaimed by Garry Hamel and C. K. Prahalad (1994), urging corporations to develop foresight in order to compete for the future, and eventually have a future.

In the USA there seems to be contradictory evidence that the role of corporate foresight will increase or that it will decrease. However, in Germany it can be observed, that a growing number of corporations are employing corporate foresight managers or futurists, and are establishing future oriented think-tanks. There seems to be a strong ongoing interest. This is not only reflected by the increase of activities in the field of corporate foresight, and an increase in the number of consultancies and think-tanks, but also by the increasing numbers of conferences on foresight in Germany.

Little research has been done till now on the proliferation of corporate foresight in Germany. One notable exception is a study of the German consultancy Z_punkt on futures studies in German corporations (Burmeister et al. 2002). What seems to be of particular interest is how corporate foresight will evolve in the future in Germany. Also of interest is what methods will be used in corporate foresight and what does the field need to accomplish to foster a rise of acceptance in the future, pointing out to future fields of research. In addition the objective of this study was to assess the status-quo of corporate foresight in German companies.

A Delphi Study involving Corporate Managers

The Delphi method is credited with being applicable when a question shall be answered which lies in the future, which seems to suit the proposed questions. The Delphi method was developed by Olaf Helmer and Norman Dalkey in 1953 at the RAND Corporation with the aim of improving the use of expert opinion in policy-making. The core of the Delphi technique is that a pool of experts deals with certain problems which lie in the future. During this process the experts do not have any contact with each other, their opinions are submitted by questionnaires.

This particular Delphi study on the future of corporate foresight in Germnay consisted of two rounds. In the first round the participants received the questionnaire, consisting of quantitative and qualitative questions. In the second round the members of the panel received the results of the first round. In the light of this information the members of the panel were asked to revise their expressed opinions.

An essential feature of this particular Delphi study was that experts from three groups were invited to participate: corporate managers working in a strategic context, criteria were an annual turnover of at least €500 million and more than 10,000 employees; second, futurists at think-tanks and consultancies (futurists); and third, scientists in the field of management and scientists who deal with futures studies. As can been observed in the figure below, the largest group was the one of corporate managers, reflecting the focus of this Delphi study.

In the first round of the Delphi study 84 participants filled out the questionnaire. 64 of them responded in the second round and returned their comments concerning the results of the first round. The response rate for the second round was 76 percent.

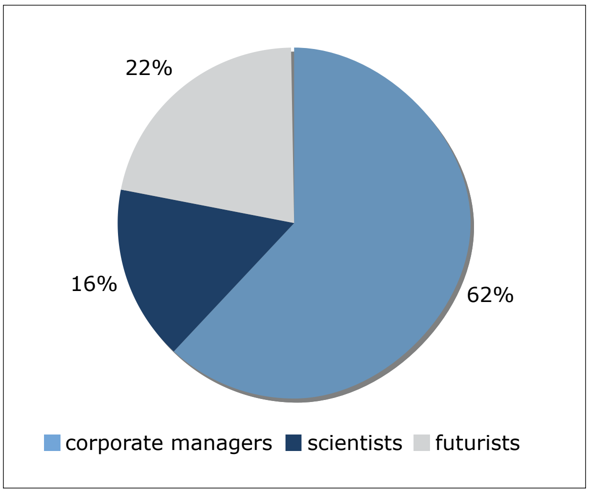


Figure 1: Group proportions, 2nd round

Mix of Methods to Assess the Use of Corporate Foresight in Germany

It remains difficult to find a commonly shared definition of corporate foresight or of futures studies in a corporate context. In particular since corporate foresight is labelled very differently in companies, this study chose the approach to focus on the methods used in corporate foresight, so it would be easier to assess the status-quo and future of corporate foresight in German companies.

After reviewing the literature on futures studies and foresight (e.g. Masini, 1993; May, 1996) the following methods were identified:

- **Quantitative forecasting:** Referring in particular in a business context to the quantitative methods of business forecasting.
- **Simulation and gaming:** Both methods can be perceived as being decision-aiding technologies involving mathematical modelling.
- **Delphi technique:** Method to assess expert opinions on a subject which lies in the future.
- **Scenario technique:** The main aim of scenarios is to identify existing trends and key uncertainties and combine them in pictures of the future, not covering all eventualities but creating alternative pictures of the future. Royal Dutch/Shell has been credited for developing the scenario technique further in the 1970s into what is nowadays known as scenario planning, connecting the scenario technique with strategic planning.
- **Environmental scanning, trend monitoring, trend research, strategic early warning:** The purpose of this group of methods is to identify weak signals of change in the corporate environment ahead of time, leaving the corporation time to react strategically to these changes.
- **Creativity:** Under the heading of creativity all those methods are summarized which foster creative thinking about the future, e.g. brainstorming or the future workshop.

In the following the results will be displayed which are concerned with the status-quo of corporate foresight in German companies.

The participants of the group of corporate managers were asked in the first round to state how frequently the above mentioned methods have been used in the past in their company, the answers are displayed in Figure 2. Combining the figures for "frequently" and "occasionally" one can conclude that the methods used most in German corporations are environmental scanning, trend monitoring, trend research, strategic early warning and the scenario technique, followed by quantitative forecasting and those methods for thinking creatively about the future.

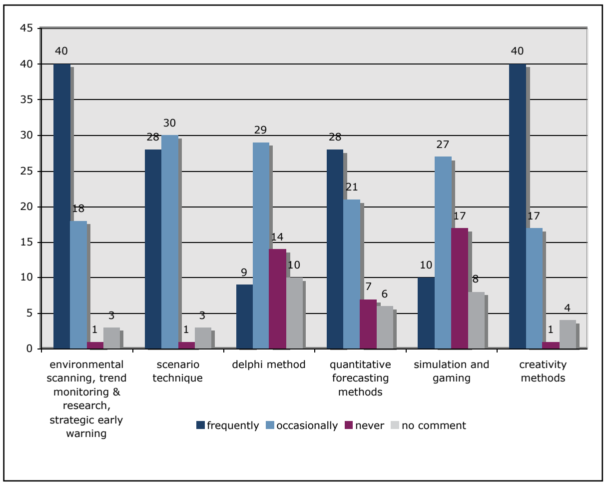


Figure 2: Methods being used
(1st round, corporate managers only)

Acceptance of Corporate Foresight on the Rise

Other questions concerning the status-quo of corporate foresight revealed that 36 percent of corporate foresight activities are carried out by single employees, followed by 28 percent in own departments. Only 18 percent of the corporate managers stated that corporate foresight is an integral part of the planning process or that external consultants (17 percent) are brought in. The results further revealed that corporate foresight is carried out by 56 percent in departments such as strategy, planning, corporate development or marketing and only 23 percent of them in technology focused departments. Most interestingly, 71 percent of the corporate managers stated that the acceptance of corporate foresight in their company is rising. Only 9 percent stated that the acceptance is declining.

How Much Do Mangers Know about Foresight Methods?

In the following those results of the Delphi study will be presented which are concerned with the future of corporate foresight in German companies. In figure 3 the results are displayed which concern the question which methods of corporate foresight are likely to experience a rise in interest in the future. Combining the positive answers (“strongly agree” and “agree”) one can conclude that the methods of environmental scanning, trend monitoring, trend research und strategic early warning (86 percent) and the scenario technique (83 percent) are most likely to experience a boost in interest in the future. The lowest figures were received by the Delphi technique (48 percent) and simulation und gaming (47 percent). What seems to be significant, however, is the high amount of neutral answers which might be an indicator that several methods of corporate foresight are not very well known, in particular among the group of corporate managers.

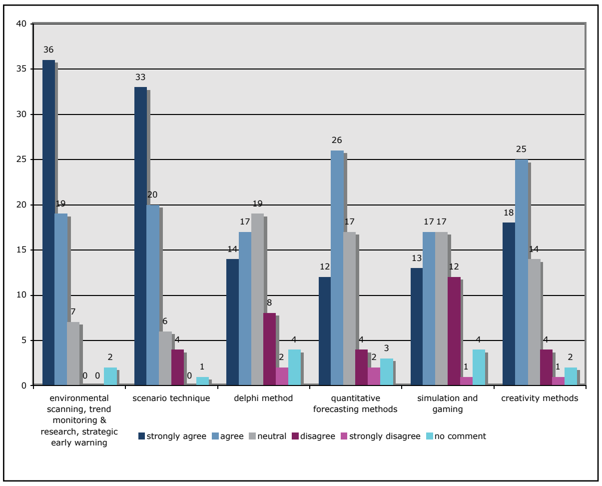


Figure 3: Methods which importance will increase (2nd round, entire panel)

Detecting Chances of Corporate Environment

The three methods which were mentioned most frequently in the Delphi study as those which need to be improved were the scenario technique, quantitative forecasting methods, and strategic early warning. Various panellists stated that it would be less important to develop new methods but to better implement those existing more successfully, to get them to work better in practise. The scenario technique in particular should be more strongly integrated into strategic planning and should also be designed for the use in smaller companies. Stressing the issue of implementation: panellists expressed the view that it is essential for corporate foresight that the results of such activities are adaptable for a corporation.

The methods which received the most credit from the panel, were those concerned with detecting change in the organisations environment ahead of time, such as environmental scanning, trend research and strategic early warning. This implies that the first concern of the panellists is to understand and detect those changes underway, laying the foundation for a foresight activity and then thinking about the future.

Need for Customized Results

Implementation was a principal issue in this Delphi study. The study revealed a degree of scepticism of corporate managers towards applying methods of corporate foresight in their company. One could conclude that the need to apply corporate foresight is accepted, but that the difficulties and problems in using these methods obstruct a further rise in acceptance. The recognition of corporate foresight is of course related to the extent to which the results are adaptable and are of use. However, one major concern of the panel was that the implementation of corporate foresight activities needs to be less complicated and that the contents need to be designed to fit the demands and requirements of those who are supposed to work with these results. One could therefore conclude that those who have been exposed to corporate foresight and have experienced difficulties in implementation view the further development in their own organization a little more sceptically. Overall, the opinion was expressed, that corporate foresight should be kept simple, less time consuming, less academic and easier to integrate and implement in corporate processes. Corporate foresight should be different from crystal ball gazing and journalistic trend research.

The panellist expressed the opinion that the aim of corporate foresight should be to focus less on prediction and more on detecting changes in the environment of an organization. This is also reflected in the positive perception of the development of environmental scanning and strategic early warning.

Concerning the image of futures studies the term foresight should be promoted, in order to work against the negative image of futures studies, in particular in corporations.

How to Implement Corporate Foresight and its Results?

The results of the Delphi study suggest that corporate foresight has a foundation in German corporations. This study underlines the importance of further improvement of environmental scanning, trend research, trend monitoring, strategic early warning and the scenario technique. Methods which are concerned with creating alternative pictures of the future and detecting change in an organizational environment and also keeping track of these changes should eventually allow to react strategically to these changes. The message behind this selection of methods is that the need to prepare a company to deal with the future and develop foresight is understood and that simple predictions or forecasts are avoided. This in return is a good indication of the acceptance of corporate foresight in German companies.

The biggest challenge for corporate foresight will be to improve its implementation. While the results of the Delphi study do not suggest that new methods are needed, implementation was described as the major concern. The key to further acceptance of corporate foresight is to improve the implementation in such a manner that the outcome of these activities match the demands of the potential recipients and that the results are adaptable. This discussion marks the future research question: how to implement corporate foresight, how to apply it and how to understand the organizational and cognitive challenges. The question needs to be raised how much the organization or rather the corporate culture needs to be changed in order to deal with methods which tend to deliver uncertain results, as demonstrated for instance by the implementation of a strategic early warning system (Schwarz, 2005).

The Delphi study was able to answer the question about the potential of corporate foresight in German companies. It captured a wide variety of opinions and provided an insight into two essential issues: first, the status-quo and second the future of corporate foresight. Corporate foresight is highly regarded in German companies but the scepticism described in this study has proven that further development is essential.

References

- Burmeister, K.; Neef, A. & Beyers, B. 2004. *Corporate Foresight*. Hamburg: Murmann.
- Burmeister, K.; Neef, A.; Albert, B. & Glockner, H. 2002. *Zukunftsforschung und Unternehmen*, Essen: Druck- und Verlagskooperative stattwerk.
- Hamel, G. & Prahald, C. K. 1994. *Competing for the Future*. Boston: Harvard Business School Press.
- Masini, E. B. 1993. *Why Futures Studies?*, London: Grey Seal.
- May, G. H. 1996. *The Future is Ours: Foreseeing, Managing and Creating the Future*. UK: Adamantine Press.
- Schwarz, J.O. 2005. 'Pitfalls in implementing a strategic early warning system'. *Foresight*, 7 (4), 22-30

The entire study has been published: Schwarz, J. O. 2006. The Future of Futures Studies – A Delphi Study with a German Perspective. Aachen: Shaker. Further information is available at **www.delphi-studie.de**

Russian Critical Technologies 2015

Author	Alexander Sokolov/ sokolov@hse.ru		
Sponsors:	Ministry of Education and Science of the Russian Federation, Federal Agency for Science and Innovation		
Type:	National Foresight exercise		
Organizer:	Ministry of Education and Science of the Russian Federation		
Duration:	2004-2005	Budget: N/A	Time horizon: 2015

Purpose

The Ministry of Education and Science of the Russian Federation conducted a foresight exercise aimed at identifying national S&T priorities and developing the list of critical technologies. The study was organized on a new methodological basis compared to the two previous exercises undertaken in 1996 and 2002. The results obtained were used as a background for the Federal Science and Technology Programme.

A New Approach to S&T Priority Setting

Russia's agenda setting for S&T priorities has been undergoing a transformation for the last 30 years. The last definitions for S&T priorities and critical technologies were approved in 2002 and represented research areas that were too broad to become real targets for the implementation of S&T policies by the Russian government. Neither did these priorities provide orientation for private investment. Hence, Russia's Ministry of Education and Science organized activities to revise and correct the process in the period 2003-2004.

Revision of S&T Priorities

The revision of S&T priorities was carried out during a period of sustained economic growth and great improvement of the state government system. According to international experience, long-term sustained development is achievable only as a result of high entrepreneurial and innovation activities both in production and service sectors, diversification of production and greater share of sophisticated and high-tech products. Thus concentrating resources in the areas where Russia's competitive advantages can be implemented helps faster introduction of innovation based on latest research outcomes and technologies, which at present is a key factor that determines the competitive status of the national economy. Such restructuring of the national economy is of particular importance for Russia because of its strong dependence on the international markets of fuel and mineral resources.

One of the main objectives in revising the priorities was to create an information and analysis background for defining budgeting priorities and forming the Federal S&T Program 'Research and Development in Priority Areas of Science and Technology,' as well as for other federal and sectoral goal-oriented programs, eventually resulting in greater efficiency of public funds invested into S&T.

Economic Growth as a Driver

Given Russia's new economic development model, with its goal of faster GDP growth, greater increase of competitive capacity of the national economy and its diversification based on high technologies, the revision of priorities had a practical purpose, in that the newly formulated lists of priorities and critical technologies were to be correlated with industry's needs so that they could serve as a basis for managerial decisions on intensification of innovation activities, practical implementation of the existing research capacities and concentration of public R&D funding in the most important S&T areas. The revision of the priorities had the following general objectives:

- Developing criteria for evaluating technologies,
- Analyzing components of existing critical technologies, assessment of their use for developing innovation products, competitive in domestic and foreign markets,
- Identifying research areas within critical technologies with the greatest potential for developing such products and making a considerable contribution to increasing GDP growth and the competitiveness of the economy,
- Creating revised lists of priorities and critical technologies together with recommendations on their use,
- Evaluating the innovation potential of critical technologies,
- Developing proposals concerning practical implementation of the selected S&T priorities.

Identifying Critical Technologies for Civilian and Security Related Use

Critical technologies were selected based on the 10-year horizon (up to 2015) of their practical use, with a particular focus on those nearest to a practical implementation stage. The main objectives of Russia's Social and Economic Development Program for the medium term consist in overcoming factors hindering GDP growth and reducing the present dependence on the fuel and raw materials as the mainstays of the national economy. Given these requirements, it was decided to use the following **two main criteria** for correcting the lists of priorities and critical technologies:

- Their contribution to accelerating growth and enhancing the competitiveness of Russia's national economy.
- Their capacity for enhancing Russia's national security.

The capacity for enhancing Russia's national security was assessed based on the following factors:

- Overcoming dependence on imports of particularly important goods and technologies,
- Competitive capacity compared to their foreign equivalents (price and technological characteristics) of domestic technologies for reducing technogenic catastrophic risks.

In selecting critical technologies for the civil sector it was decided to restrict their number to a minimum due to the need for concentrating resources. Thus it will be possible to provide sufficient budget funding for each of the critical technologies through the federal S&T program 'Research and Development in Priority Science and Technology Areas.' Furthermore, the following additional criteria were used for evaluating critical technologies:

- Precise and accurate formulation.
- It was decided to identify breakthrough technologies with applications capable of providing growth rates in specific product groups that would far exceed average domestic growth rates, or that can generate a large range of innovations in different social and economic sectors.
- A variety of possible applications in different social and economic sectors, generation of new research areas.
- Conditions for practical implementation. Priority was given to critical technologies that might be met with demand in the most rapidly developing sectors of the national economy.
- Investment required for industrial application,
- Assessment of probable risks.
- Applicability in the framework of public programs.

Involving National Actors

All interested government agencies and ministries took part in the review of the S&T priorities and critical technologies. In 2003-2004 the Ministry for Science and Education collected their proposals and arguments in favour of keeping formerly listed critical technologies or including new ones into the revised list. They were systematized and evaluated by experts engaged by the Ministry for Science and Education.

Use of Expert Opinion

Additionally, leading Russian scholars and specialists took part in the evaluation of all the priorities, two surveys were conducted and several expert panels established for this purpose. At the initial stage, a preliminary poll was held concerning each proposed priority, with questionnaires submitted to experts in order to gather information on the most important prospective innovation products and services, as well as on technologies that might play a critical role for those innovations.

The subsequent selection procedure was used to choose the products. Each expert was asked to name 10-12 important innovation products (services) from his sphere of interest and occupation, that could be produced in Russia with the help of domestic S&T developments in the nearest decade and that would meet the following criteria:

- **Competitiveness**
- Considerable contribution to **GDP growth**
- **Overcoming dependence on imports**

The experts were also asked to describe the main features of each of the products and identify technologies that need to be developed for their creation. The information on the products thus obtained was systematized and offered to expert panels for discussions in several rounds that were held concerning each priority. During the expert panel discussions, the original set of products was reviewed and major innovation product groups were identified according to the above mentioned main priorities. As a result of expert panel discussions, there was formed a set of the most important innovation products and services that can be produced in Russia in the next 10 years. As a rule, the sets encompassed approximately 20-30 product groups in each priority area.

For each innovation product the following issues were assessed: projected annual volume of sales both in Russia and abroad, competitive capacity on both domestic and foreign markets, the possible date for launch of production, the ownership of technologies required for production, availability of production facilities, etc. Furthermore, the experts identified several Russian organizations that possess technologies required for launching the production of major innovation products and provided other information such as barriers, measures to be taken before production can start and the availability of qualified human resources. In assessing products in the area of ecology and rational nature utilization, the questionnaires were slightly modified. Thus, instead of evaluating sales volumes, the experts were asked to evaluate the prospective annual ecological effect so as to prevent damage to ecology and reduce environmental protection costs.

Russia's Priorities Correspond to International R&D Agenda

As a result of the above described process the following documents were prepared:

- Draft of revised list of priority areas of S&T development,
- Draft of revised list of critical technologies,
- Description of the main features of critical technologies such as basis for inclusion into the list, major prospective results, key research areas, leading Russian R&D centres involved in research, tendencies and prospects for creating innovation products based on technologies in question in Russia and abroad.

In the course of the final stage of the process ministry officials and experts reduced and considerably modified the earlier approved list of priority S&T areas. The new list included eight priorities:

- Information and telecommunications systems
- Nano-systems industry and materials
- Living systems
- Rational nature utilization
- Power engineering and energy saving
- Transport, aviation and space systems
- Safety and terrorism counteraction
- Prospective armaments, military and special equipment

The first six correspond to the current international technological development priorities. They possess the greatest innovation development potential that is defining the formation of new global markets. This is particularly true for information technologies, nano-systems industry and new materials and living systems. These last two priorities on the revised list relate to national security.

Critical technologies are also instrumental in providing national defence and technological safety. Just like the list of priorities, this list underwent major changes as well.

Priority S&T Areas Content and Innovation Capacities

In **information and telecommunication systems** priority will be given to technologies for creating intelligent management systems for complex objects and navigation systems, technologies for transmitting, processing and protecting information, technologies for software development and technologies for computation systems. As a result, it will allow developing within a short period of time such novel products and services as intelligent systems for supporting complex equipment operators and creating automated production facilities; intelligent robots; smart houses and vehicles; systems for a single telecommunications network encompassing the Internet, television, radio, various multimedia and virtual reality systems; automated systems for contacts with government agencies at all levels; standard electronic identification documents; distance education and health care systems, etc. that will have far greater quality and effectiveness than similar products of older generation.

In nano-systems industry and materials the most important breakthroughs can be expected in the sphere of nanotechnologies and technologies for Mechatronics and Microsystems equipment development; technologies for creating crystals; developing and processing materials with special qualities, composite and ceramic materials, polymers and elastomers. There is hardly any area in the aviation and space industry, transportation, electrical power industry, oil industry, microelectronics or medicine that can develop without such materials. These critical technologies are also important for resolving the existing ecological problems. Some of the most important innovation products and services in this area, which are likely to have the greatest economic effect, are ceramic and composite materials with functional properties. They could have applications as super ion-conductors, superconductors or magnetic materials.

In living systems, technological development is going to be defined by cell technologies, R&D in stem cells and bioengineering and biosensor technologies. Bio-information technology development together with genome and post-genome technologies for creating pharmaceuticals will lead to the emergence of a new generation of pharmaceuticals using membrane proteins and receptors as targets. Among other notable innovation products and services based on living system, critical technologies that can be launched into the economic turnover in the nearest future are, for instance, new analytical devices for medical diagnostics, the introduction into practical farming of transgenic plants with improved features and using them for producing various physiologically active substances.

In **rational utilization of nature**, the main areas of technological development will result from more sophisticated technologies for environmental monitoring and forecasting together with the introduction of technologies for ecologically safe mining and oil and gas extraction, as well as for processing and utilizing technogenic substances and wastes and decreasing the risks and minimizing the consequences of natural and technogenic catastrophes. The following products with the greatest ecological effect can be named here: technologies and devices for minimizing negative consequences for human health and environment of natural and technogenic emergencies and systems for utilization and burial of highly toxic wastes, for restoring water quality in surface water objects, for industrial and public waste and drainage water treatment, treatment of medical wastes and biological wastes from food industry and agricultural facilities.

In **power engineering and energy saving**, the most important areas are fast neutrons nuclear reactors, hydrogen power research, broad scale introduction of various renewable energy sources, and power generation from organic fuels. There are domestic technologies in these areas as well as production facilities for manufacturing plants and equipment for hydrogen power generation, ecologically safe and highly efficient hybrid power plants based on high-temperature fuel elements, highly efficient steam and gas turbine plants, and other competitive products meeting the best foreign equivalents. Some of the most important priorities for technological development are creating power-saving transportation systems, heat and electricity distribution and consumption systems based on superconductor and semiconductor devices, etc.

In **transport, aviation and space**, priority will be given to technologies providing production of new competitive types of high-speed land transport, navigation systems, aircrafts, rockets and long-distance space ships, as well as integrating Russian technologies into global value-added chains.

Technologies and Their Estimated Contribution to Growth

The experts pointed out that the area of **information and telecommunications systems** has the greatest innovation capacity. According to some estimates, the export of software amounted to approximately US$ 400 billion as early as 2000, mostly accounted by offshore programming services. Export forecasts for 2010 are as high as US$ 2-4 billion. Recent government initiatives aimed at developing ICT innovation centres to make the industry's prospects even more optimistic.

The area with the next greatest possible production volumes is **power engineering and energy saving**, where Russian companies are capable of achieving sales volumes of US$ 3-4 billion, with several dozen million dollars' worth of exports.

In **biotechnologies**, the 2004 exports of immuno-biological and antibiotic substances alone amounted to US$ 35 million, and they may reach US$ 100-120 million by 2010.

In **rational and sustainable use of nature** the highest economic effect can be expected from hydro-meteorological support of various sectors of the economy, from accurate forecast and prevention of natural and technogenic catastrophes, from ecologically safe mining and prevention of ecological damage.

Competing on the Global Market

If Russia succeeds in developing these technologies, it has a chance to retain front-rank positions in many S&T areas. In many of these fields the country has stable research teams, capable of conducting R&D at the best international standards, and in some of them Russia is an acknowledged leader. Most of the critical technologies can provide innovation products with large potential markets within a short time period and at comparatively low additional investment cost, thus contributing to the declared task of doubling GDP and improving the quality of economic growth by increasing the share of science-intensive products.

Input to the National S&T Programme

The new list of S&T priority areas and Critical Technologies has been approved by President of the Russian Federation. It was used by the Federal Agency for Science and Innovation as a background for the Federal Science and Technology Program implemented in 2005-2006. The new National S&T Program to be implemented in 2007-2012 is also designed in line with the lists of S&T priorities and Critical Technologies. The detailed results obtained during the exercise were used for selection of big innovation projects jointly funded by the government and private businesses. The lists also create a basis for development of S&T priorities for particular regions and industrial sectors.

Sources and References

http://www.mon.gov.ru/

The 'Jordan 2020' Scenarios Project

Author	Majeda Assaf (Author) at the HCST in Jordan/ majeda@hcst.gov.jo Sami Mahroum (Editor)/ Sami.Mahroum@arcs.ac.at		
Sponsors:	The HCST - Higher Council for Science and Technology, Jordan		
Type:	National Foresight Exercise		
Organizer:	The HCST - Higher Council for Science and Technology, Jordan		
Duration:	2000-2002	Budget: € 90 000	Time horizon: 2000-2020

Motivation

The project aimed at formulating all plausible future scenarios for Jordan in the year 2020 and enabling decision makers to draw realistic policies and strategic decisions directly relevant to the said scenarios. It also aimed at stimulating national dialogue on future-related policies, allowing stakeholders to participate in shaping their future, rather than merely being affected by it.

Bridging the Development Gap

Subsequent Human Development Reports, for example by the United Nations Development Program, UNDP, and Jordan's Ministry of Planning, on Jordan have highlighted a number of persistent facts about the country. Jordan is considered one of the two Arab countries whose ranking in the Human Development Index is valued at higher than its ranking as regards to its per capita income. This indicated that Jordan has invested its scarce resources in a relatively effective manner, translating them into assets in human and social development. These reports also show that Jordan achieved the highest ranking among medium income countries in the Human Development Index. On the negative side however, the index indicated that Jordan's progress in education and health was not accompanied by an increase in income levels and that the level of women's participation in economic activities was still very low.

Against this background, and in response to the instructions of HRH Prince El-Hassan Bin Talal, Chairman of the HCST - Higher Council for Science and Technology, the HCST took the initiative in dedicating what futuristic studies can offer to enable decision makers to draw realistic policies built on profound scientific studies through Jordan 2020 Scenarios, towards the shaping of alternative future visions to confront the challenges to come.

The first launching seminar chaired by HRH, chairman of HCST, and convened in August 2000, formed the real beginning of the Jordan 2020 Scenarios Project under the patronage of the Higher Council for Science and Technology.

A Two-Stage Approach

A **consultative steering committee** supervised the first phase of the project. Five committees (Natural resources, Human resources, Economics, Society, and culture.) were also formed for the different dimensions, made up of experts in the field. The committees entrusted experts/ an expert with the preparation of a reference paper for the different scenarios in each of the dimensions mentioned. Around 70 experts were in the due process. The papers were reviewed and discussed during the course of **the seminar** launching each dimension and were resolved upon to move ahead in formulating different **scenarios** for Jordan. Besides decision-makers and representatives of public and private sector institutions and experts, representatives of all sectors of Jordanian society attended the seminars.

Since the starting point for the scenario formulation is to understand the society dynamics, the project started out by defining the forces that propel change at the domestic level, and those that control the procession of our world, present and future, at the international level. Seminar participants identified their views on the effect each of these driving forces had on the others on special forms that were distributed for this purpose (no effect, weak effect, moderate effect, powerful effect).

The cross impact of the effect of these potential driving forces was interpreted according to the responses of the participants utilizing the **cross impact analysis matrix** and the results were shown through calculating the total impact of each force.

As for stage two of the project (formulation of **three plausible future scenarios**), the formulation of the three scenarios in their final form has been made final after a **series of seminars and brain-storming meetings** in which a number of professional experts, "men and women of thought", decision makers, and representatives of civil society participated in addition to the members of the various scenario committees.

The scenario formulation was based on a wide set of sectoral study reports on various subjects to enable the formulators to acquaint themselves with some of the aspects of these subjects, and to shed some light on issues of certain importance to deal with them from a specialized view point. After that, the scenario was formulated in draft form, reviewed and amended by the Steering Committee in light of internal debate with the respective scenario committee, and then presented and debated in a seminar of the type described above before it was put in its final form.

3 Scenarios for Jordan in 2020

'Jordan 2020 Scenarios' yielded a general framework for three possible distinct scenarios for Jordan. These were:

- **The Referential Scenario,**
- **The Evolving Scenario, and**
- **The Innovative Scenario.**

The Referential Scenario draws a picture of Jordan in 2020 based on **'business as usual'** principle. The Innovative Scenario, on the other end of the scenarios' spectrum, draws a different picture for Jordan in 2020 on the grounds that **innovative reforms** take place. The Evolving Scenario, somewhere in between the two, draws a picture of Jordan in 2020 if the recommended **sectoral policies** and current thought of **creative ideas** take place.

The 'Referential Scenario'

Perhaps the more important findings in the three scenarios are that the **Referential Scenario** shows, in the political scene, a weakness in the democracy rooting process, a regression in the quality of Parliamentary representatives, and a marginalization of the role of political parties. It further shows a strengthening of the phenomenon of political saloons, tribal and regional societies, and a weakening in the role of civil society organizations. **The scenario shows that encouraging women to participate in the political life has yielded good fruits** by which women were able, in reasonable proportions, to win elections to Parliament despite the obstacles that the election law put in their way.

With regards to Jordan's role in the region, the scenario tells of ordinary Jordanian Arab relations and that **the style of interaction with the Arab States is not conducive to establish strategic ties with them**.

On the economic front, the Referential Scenario shows that **economic growth remains modest**, that the per capita share of the Gross Domestic Product, GDP, did not double in twenty years, and shows modesty in the production of goods and services, a recession in agricultural production, and a modest growth in tourism. Additionally, it shows that Jordan's indebtedness increases to about 10 billion dollars. Industrial growth advances slowly and so do the workers in this sector. Privatization continues with success but its funds are not utilized in accordance with a clear strategic program.

With regard to natural resources, the scenario points to the lack of long term national strategies to face the **problem of water shortage**, and the continuity of reliance on **oil imported from Iraq** as a source of energy.

On the social front, **unemployment** persists, and **migrant labor, crime and drugs remain as unsolved problems.**

On the education front, the Referential Scenario shows a recession because of the **slowdown in the domestic education economics;** the teachers' situation remains the same, and, despite the expansion in schools and universities, education reflects quantity rather than quality, a factor that feeds unemployment among the graduates. The scenario shows that Jordan has succeeded in the introduction and the **expansion of computers in the education system,** but the problem of scientific research remains unchanged and so also does the problem of cultural transformations.

The 'Innovative Scenario'

The **Innovative Scenario** shows a return of **Parliamentary life**, and the emergence of a role for the **political parties** on the national arena with an expanding role in building thought. It also shows the establishment of **civil society organizations** that cooperate to start a **dialogue between the Arabs on one side and the Europeans and Americans on the other**. The scenario tells of the raising of the ceiling of freedom and of an **expanding role for women in political life**.

With regards to economic development, this scenario shows the government continuing on the road of **privatization of major industries**, especially the **Potash and the Phosphate industries,** and the expansion of production of the **Arab Potash Company.** It shows more of management contracts that the government enters into with foreign firms to **manage the water and wastewater systems,** and tells of programs to develop

agricultural programs and agricultural marketing of Jordan Valley products. It notes the **expansion of export markets, increase in foreign investment** especially in the **Aqaba Special Economic Zone**, and the **reduction of income tax.**

Regarding the natural resources, exploration for oil and natural gas continues, and a concession is granted for the exploitation of oil shale. Government invests in programs to develop the Badia, and becomes active in the **protection of natural resources** and their development. It conducts **exploration for freshwater** in the sandstone layer in certain areas and initiates a project to supply Amman with water from these sources. The government adopts a strategy to **treat municipal wastewater** and its reuse in agriculture.

The Innovative Scenario shows the beginning of development of **higher education** and the steering of it towards **financial independence**, **privatization of university education and the conversion of state universities to non-profit universities**. Additionally, there is increased attention paid to culture and an emphasis placed on science and technology and the role of scientific research in development. Decentralized education systems are adopted, and training using the internet becomes in vogue, a factor that nourishes innovation and excellence.

The 'Evolving Scenario'

The Evolving Scenario shows the **return of Parliamentary life** with participation from **opposition Islamist and Pan Arab parties, the annulment of personal privileges** that were given to deputies during the fourteenth Parliament, and the cancellation of the one person-one vote law.

Economically, the scenario shows the preoccupation of government to improve the **investment climate in the exploitation of the mineral resources of Jordan, the sale by government of half of its shares in the phosphate and potash companies** to two strategic partners, the beginning of improvement in **foreign investment** and indicates that the privatization process has reached its zenith. The scenario shows the success the **Aqaba Special Economic Zone** achieved justifying the thinking to establish similar zones elsewhere, and the **reduction in unemployment rates**. It tells of the **establishment of a joint council for economic cooperation** between them, and of the deregulation of the exchange of all commodities traded between them, the annulment of all negative lists, the deregulation of the movement of labor between them exempting the workers from the requirements of visas and residence permits.

Concerning the natural resources, the government engages itself, in the process of **improving the investment climate in mineral resources, in reforming the legal framework that regulates the exploitation of natural resources**, and amends the laws pertinent to some establishments concerned with natural resources. The scenario shows an **alliance developing between the Phosphate and Potash companies** and the establishment of **advanced chemical industries.**

On the social front, the scenario shows continuity of **unemployment, the widening of the poverty circles, juvenile delinquency, and crime**, but shows support for organizations of civil society and the enactment of the **child protection law.**

In the education sector, this scenario sees the **connection of major schools with the national communications network**, and **teaching computers** as a basic course in the secondary education cycle. The government starts to reform and **modernize the university education system**, and freedom is given to the establishment of private universities. **Government subsidy to state universities is lifted**, and, in its stead, a fund for the support of needy university students is established. **A Ministry of Human Resources is constituted**, and the programs of the Vocational Training Corporation are privatized.

The wide participation by all segments of society, considered an important pillar of this project, gave it a special attractive color; the feed back from every seminar was an important tributary that contributed to the enrichment of this project and to the enhancement of its chances of success.

The Way Forward

In an effort to institutionalize policy dialogue the Higher Council for Science and Technology took the initiative to establish a specialized centre affiliated to the Council. «The Jordan Centre for Public Policy Research and Dialogue» was established in 2004.

The Objective of the centre is to enhance the participation of civic society in matters of public nature through conducting scientific analysis on issues and policies of concern.

The demand on the project documents by government institutions, universities, research centers, and individuals was high. HCST staff was also invited by all concerned institutions to give lectures on the scenarios and their outcomes. The College of Defense included the scenarios in its curriculum.

Sources and References

- The **'Jordan Human Development Report 2000'** by the United Nations Development Programme, UNDP and the Ministry of Planning, Jordan.
- Dr. Khaled El Shraydeh, Director of the Higher Council for Science and Technology.

Aufbruch Musik - German Music 2020

Authors:	Agnes Pechmann / pechmann@dialogik-expert.de		
Sponsors:	The Strecker Stiftung provided financial support Other organizations, companies and individuals provided non-financial resources		
Type:	A national foresight on the German music sector		
Organizer:	'Aufbruch Musik' is a group of nine people with ties in all areas of the music sector coming together from different organizations and institutions for the project. The group can be contacted via Barbara Haack / hack@nmz.de Claus Harten / harten@harten-breuninger.de		
Duration:	2005-2006	Budget: € 20 000	Time Horizon: 2020+

Background

The music sector in Germany is going through major changes. Global technological and societal trends combined with major cuts in public spending for the cultural sector need to be faced. Right now these upcoming changes seem to be met by agitated melancholia instead of orchestrating these changes to a desired state of the future where music is established as an energy source for societal and personal development. The time to refer to the glorious German music transition rectifying public spending for 'high quality' music seems to be coming to an end. The border between different music lines has become more and more blurred.

Music Actors 'Jiggle' their Sector

Music is an essential part of Germany, not only seen in a cultural sense for its society but also for sociological and economic reasons. To give a few numbers:

In Germany over 2,700 music and sound storage companies exist with nearly 80,000 permanent employees. They create a business volume of 14,500 Million. The mass media broadcasting and consumer electronics are not included in this number. In addition to the employees with permanent contract there is a traditionally high percentage of self-employment and short term contracts, probably 50% of the total job market. 13.5% of the German population over 14 years of age play a musical instrument (See Endnote 1).

A private initiative

The German Music foresight project is initiated by nine individual actors from different areas of the music sector. Though these individuals are of different disciplines and work in different areas and on different levels, they share, next to their love of music, at least one other thing: The opinion that the German music sector needs to start acting soon if it wants to be able to orchestrate the upcoming changes. This is even more important if the German music sector wants to remain as an important player an important player in the world music scene. Otherwise the condemnation into music world insignificance is a real threat. The group 'Aufbruch Musik' - Music Decampment - has decided to join forces in order to wake up the music society to reality and to launch them into the future.

Since this is a major change process the group decided to split this enterprise into two parts to:
- Keep its handling feasible and
- To be able to finance it.

The first part of the enterprise is the German Music foresight, which is the topic of this brief. The exercise is not financed with public money but financially by the Strecker Stiftung - a foundation.

The objectives of the German Music foresight are:
- to raise awareness that the music sector is in a process of fast transition while acting like a sleeping beauty,
- to disclose how the global musical and societal trends are seen by music professionals and the music public,
- to make the people in the sector aware that they actively need to shape the process of change.

By achieving these objectives, the goal to initiate a second foresight process with an even broader and more active participation of the various actors will be achieved.
The objectives of the second foresight will be:
- to develop scenarios for the different music fields, to
- to engage the music public at a major music congress in Germany, and to
- to develop desirable visions for the different field of the music sector.

The music sector combines totally different fields. Examples of this are: the different music styles such as serious/classical music, opera, folk, jazz, pop, rock, music lay education, professional education, music literature, music therapy and others. Areas which are covered by this sector as well are the fields of music broadcasting – radio and television, music storage, music theatres, concert organization, music production and the manufacturing of music.

A Classical Foresight Approach

The German music foresight is a foresight exercise in a classical, participatory sense.

In a preparatory phase, global trends have been collected based on a literature review and experts in the different fields of the music sector have adapted these trends onto their fields and outlined possible results of these trends in 2020 in a working paper.

The main phase of the foresight consisted of a survey. Based on the working paper two types of interviews were planned: Guided interviews with at least two experts from the more than 15 different music fields and standardized interviews. The standardized interviews have been made available to the interviewees either as on-line or as a printed version (the full questionnaire in German is available under www.foresight-musik.de). The music public was invited to participate in this survey by an open invitation via e-mail, by print music media and partially by personal invitation.

The survey served two purposes, on one side it revealed the thinking and feelings/fears of the music public and on the other side it stipulated reflection about the current and future situation in the music sector. The reflection of the situation by an interviewee is usually regarded as an unwanted side effect. In this case this side-effect is very welcomed in order to prepare the ground for more active involvement of the interviewee in the future process of change.

In the final phase the results of the surveys are used to draw first sketches of scenarios. These sketches are currently used to place the topic of "The long-term future of the German music sector" as the central theme for one of the next major music congresses in Germany. With these sketches the first part of the music foresight ends – though only to hand it off to a second foresight.

Though this second foresight is not part of this brief it will be explained very shortly to give an idea of the whole change process. The results of the first foresight will be explained thereafter.

The second, future music foresight, preparation already started, focuses more on the active part of the future shaping process. This implies the operational involvement of a broad range of actors of the different music fields to resemble the broad spectrum.

In the second foresight the scenario technique will be combined with the method of future work shops.

The purpose of the second foresight lays in the development of future visions for the single fields of the music sector, - and of course in developing a plan of action to initiate their implementation. The German music congress is generally attended by about 300 people representing the various kinds of musical institutions and organisations.

No Surprises ... Just Revolutionary Change

General trends which apply to the German society and its economy like an aging society or an internationalization of top performer in the labour market have effects on the German music sector as well. Therefore, it is no surprise that the trends in the music sector are not radically new, in a general sense, but they will have revolutionary impact on some fields of the music sector. Some clear trends out of the following 13 categories have been detected:

- Globalisation – Migration,
- Education – Training
- Financing
- Quality and reception of music
- Music business and business strategies
- Working environment and job outline
- Lay music
- Associations
- Media
- Technology
- Health
- Orchestra – events – opera
- Cultural policy.

Clear Trends

The results of the carried out survey demonstrate how diverse the opinions towards future developments can be. Nevertheless, some clear trends emerged. We will list some examples of those:

The demographic development will have a major effect on the municipal youth music schools who right now lean toward the age group of 3 to 21 year olds. The focus in the music schools lays on a solid education playing a musical instrument (including voice) and preparing to play classical, serious music. The decline in the absolute number of children and teenager will force the music schools to open up to other age groups, other groups of society and to new areas.

This development is supported by the cut in financial support from the municipal government.

Due to different reasons, it is seen as very unlikely that a major group of young people can be attracted to serious music.

The financial support of traditional music institutions like opera, concert houses and music organisations through public spending will decline. Institutions not being able to cope with this situation will need to close. The number of music institutions will drop.

The job market for the musician will change even more towards a market where permanent employment is the exception and either contracts for single events or for a season will be the rule.

The music-programming of the German radio and television broadcasting under public law will not exclusively be designed under quality aspects.

It is expected that on a German, European and world-wide scale intellectual property in the music area will not be rewarded in an appropriate way.

The Foundation Of Music Society Is Shaking!

In Germany the foundation of the high level music education is provided by the youth music schools. Of over 2000 music schools, about 980 of them are municipal youth music schools. They usually not only guarantee high quality teaching, they as well offer the opportunity to play conjointly with other musicians, in small ensembles, in orchestras for different age groups and very important, they provide the students with affordable instruments on a loan basis. Very often the music schools function as an entrance to the world of classical music since mostly pieces of classical music are used in the lectures. In general, the schools have the objective to provide musical education not only for the mass of young people but also for the top performer. On average the municipal schools are borne by the community to 50%.

The music education system with the municipal youth music school as basis is seen as one of the reasons why Germany is still one of the leading countries in the music sector. If the municipal music schools close down the foundation of the high-class orchestras and wide-spread music institutions will be severely damaged.

The music schools need to find new financial and organizational concepts and new concepts of attracting and keeping students (regardless of the age).

Self-Employment as the Rule

The reduction of opera and concert houses as well insecure financing of orchestras will result in fewer musicians holding permanent employee contracts. Possible effects of this could be: the pressure to deliver top performances will rise, the attractiveness of musician as a profession will decline and with this the performance level, and, consequently, Germany as an attractive country for top performer will shrink as well.

If it can (or should) not be avoided that self-employment becomes even more the rule than today, it is of urgent need to account for that in the music education as well.

Is Creativity a Synonym for Altruism?

The social situation of a major part of the German composers is alarmingly bad, despite growing revenue numbers in the music business. Composers need to earn an appropriate share of the revenue created with their products. The situation today is already bad; most of the composer cannot afford to live by their earnings as a composer. The results from the interviews show a clear trend that the situation is expected to get worse. Some signs for this are the current amendment to the German copyright law and endeavours on European level regarding this topic.

This development is seen as very critical in the music society. The apprehension is that more and more composers withdraw completely from this business, leaving composing as a hobby. This of course will have a negative effect on the amount and quality of product creation.

Music! What for?

Numerous physiological examinations prove the vegetative effects of music. The social background in which music is perceived and the musical socialization are of important in the development of the individual and of society (See Endnote 2).

It can be expected that nearly all people listen to music of whatever type. 13.5% of German's society say they actively play an instrument; half of them 'only' play in private while the other half is organized in all kinds of music organizations -from church choirs to marching bands to orchestras and other instrumental ensembles.

If so many people are actively involved in music and even more seem to enjoy listening to it, why does the music sector seem to have a problem? It should not be a financial problem. In a society where for a mass concert the cheapest tickets cost is over € 100 and the concerts are sold out in two hours, at least it should not be problem. On the other hand opera houses and music schools need to close down since they can not survive with a reduced financial budget due to cuts in public spending.

If these cuts in public spending cannot be avoided, why is it possible to support a major music festival, like the Bayreuth festival which is sold out year after year but receives € 1.7 Million of public money? It seems that values need to be clarified.

Visions for the Music sector

The music sector of Germany is in a state where the old structures do not fit with today's world anymore. Cuts in public spending, law changes, global trends heavily influencing the music scene, demographic changes, changing values; all this calls for changes in the structure and organisation of the sector itself. Though in order to alter the structures, the current situation and the pursued values and goals need to be clearly stated. Long-term strategies need to be developed.

The purpose of this German Foresight is to initiate this process of change.

Right now it does not seem clear whether the music sector is a sleeping beauty which can be awakened to the old glory (though probably based on other grounds) or if the music sector lives off the glorious old times with no power to cope with current developments and future demands. By confronting main actors of the music scene with the results of the carried out survey, the foresight organizing group's intention is to put one of the next music congresses under the theme of "Visions for the German music sector". The goal is to carry out the main elements of the planned second foresight, the development of joint visions and a plan of action, at this congress. When involving the participants of the music congress into these elements of the foresight process, actors of the whole music spectrum will be integrated.

The music sector as a mirror of society

The German music sector can be seen as a mirror image of a highly-developed society. The music sector reflects needs, values and moral concepts of a society. Right now it is a blurred image, the traditional needs and values seem to dissolve and new ones will emerge which we have not clearly grasped.

The German Music foresight initiative achieved to start the necessary process of reflection about the music future. If the momentum can be kept and the second foresight is under way it will be very worthwhile for other actors of society to watch closely. The music society is a major part of our whole society but it might be small enough to discuss its needs and values, and to develop visions to dream and stream for.

Sources and References

- www.miz.org/intern/uploads/statistik40.pdf
- www.foresight-musik.de
- www.jmd-community.de
- www.miz.org/themenportale.html

Corporate Foresight in Europe

Authors:	Patrick Becker / patrick.becker@uni-bielefeld.de
Sponsors:	Directorate-General for Research of the European Commission
Type:	Expert Survey
Organizer:	Directorate K – 'Knowledge-based economy and society', Unit K-2 'Science and Technology Foresight'
Duration:	2002-2002 · Budget: € 8 000 · Time Horizon: 2002

Purpose

Foresight activities usually aim at decision-making and priority setting in the public sectors of systems of innovation, while the other parts of the RTDI-system have been largely left out of picture: most notably all the entrepreneurial actors on the private side (who actually bring the innovations to the market). This EU-study has been launched to take a first look at the current uses, practices and impacts of foresight in the private sector. It is based on personal interviews with 18 selected European enterprises from high-technology industries, consumer goods and the service sectors. A workshop, organized in November 2002 with the participation of corporate foresight practitioners, confirmed the overall findings of the report.

Corporate Foresight - A White Spot in Foresight Activities

Decision-making in the R&T area has become increasingly complex, with science and technology being both a driver of, and driven by, social change and economic development. In this context, future foresight activities promise to generate a clearer picture of the possible long-term challenges and opportunities arising out of these interdependencies, thus providing a crucial input for strategic planning in the area of RTDI - Research, Technology Development and Innovation.

So far, however, foresight has mostly been used for decision-making and priority setting in the public sectors of systems of innovation, while the other parts of the RTDI-system – most notably all the entrepreneurial actors on the private side have been largely left out of picture. Against this background, the EU-Commission was interested in getting a first overview of the current uses, practices and impacts of foresight in the private sector – so far, a true 'white spot' in foresight activities.

This study has been launched to take a closer look at the current state of affairs in corporate foresight – its forms and functions, its main topics and issues, and its practical problems and potentials. The comparative study was based on personal interviews with 18 selected enterprises, mostly from the high-technology such as automotive, electrical engineering, ICT, and the chemical-pharmaceutical industry, as well as the consumer goods and the service sectors such as utilities, transportation, banking and insurance.

Why do Foresight in Companies?

The final objective of all foresight activities is to support developments in the areas of science, technology and society that are likely to ensure future social benefits are identified promptly. Although all corporate foresight activities of the companies under study share this common goal, they usually focus on one of the following more intermediate functions:

- **Anticipatory Intelligence** for providing background information, general future advice, and an early warning of recent developments,
- **Direction-setting** for example to establish broad guidelines for the corporate strategy but without a direct involvement in the decision making processes itself,
- **Determining Priorities** or identifying the most desirable lines of R & D as a direct input into specific funding decisions (either in a specific field, or with regard to the corporate strategy in general),
- **Strategy Formulation and Implementation**. In this case foresight activities are used as an integral part in the formulation and implementation of strategic decisions (mostly through functional accumulation, as the persons doing foresight are also responsible for strategic decision making),
- **Innovation Catalysis.** In other words stimulating and supporting innovation processes between the different partners both inside and outside the company.

When asked for the underlying rationale of foresight, the companies reported two main motives – either they are a consequence of a companies' business operation which inherently demand such a long-term orientation *internal drivers*, or they are undertaken as a proactive step to better cope with uncertainties in the business environment in general *external drive*.

Typica**l internal drivers** for corporate foresight are:
- **'Innovation leadership' strategies** which force the company to constantly monitor and react on innovation activities of their competitors, or
- Business operations characterized by l**ong product cycles** such as the automotive or pharmaceutical sector, where long-range monitoring is a prerequisite for any RTDI-decision.

Typical **external drivers** are the:
- Use of foresight as part of an **early-warning system** in order to detect future risks and opportunities, and to prepare for possible **'wild card'** events and sudden shocks,
- View of foresight as a **valuable resource to learn more** about new technologies, emerging markets and future users.

From Part-time Futurists to Corporate Think Tanks

Generally speaking, foresight in enterprises can take place at three different organizational levels: Firstly, at the **corporate level**, mainly by corporate research or by the staff of the corporate development department; secondly, it is performed – often much less extensively - by the **divisions,** technology centres and business units themselves; and thirdly by temporary task forces which overlay those two structural levels by a third, 'lateral' or 'virtual' structure.

With regard to the companies in the survey, nearly all of them reported to conduct foresight at the corporate level. Here, long-term strategic thinking predominates, and the foresight activities are usually directly attached to the administration of corporate research or corporate development. In a number of cases, there is also a special office exclusively concerned with foresight efforts. It either consists of research workers permanently (i.e. full-time) engaged in foresight activities, or it is an unit that is staffed by both permanent futurists and personnel that has been temporarily assigned for the duration of a certain foresight project.

Apart from this general classification, it becomes difficult to compare the exact forms and structures in which the firms pursue their foresight activities, as each of them has its own distinctive historical background and individual organizational set-up. In the following, therefore, all those different approaches will be subsumed under three overarching 'ideal types' that try to highlight their essential features and major differences:

The Collecting Post: In firms with a comparatively low degree of foresight activities, future-related research is mostly done in conjunction with – and strongly embedded in – other strategic R&D activities. It is mainly concerned with providing basic background information, such as competitor or patent analyses, for decision-making processes in these areas.

Because of the relatively low need for foresight input, the persons responsible for foresight are just **part-time 'futurists'** for whom foresight is only one of their several tasks, and only seldom form a separate unit. Because of the limited analytical capacity, most foresight activities have to focus on the search and collection of future-related information that is already prepared by others and easily accessible.

The Observatory: In contrast to the first type, the observatory truly is an autonomous foresight unit with a full-time staff and a budget of its own. Moreover, it also has a clear mandate to focus on future-related issues. Its particular trait is that is fulfils a highly specialized and rather singular purpose for the company, be it the identification of socio-economical trends or forecasts of future traffic flows.

Out of its **single function** follows that it also has a **single addressee** in the company - in most of the cases, the corporate development department. In order to provide such a long-term strategic intelligence, the activities of those foresight units include not only the re-use of already existing data, but they also regularly generated new, future-related knowledge. To do so, they all rely not so much on internal networks (and their external information sources) but on their own external contacts. Needless to say, these networks are mostly made up of specialists from the same or similar fields of expertise, and only seldom tap into the broader areas of foresight.

The Think Tank: The most broad and elaborate foresight work is done by **special units** which act as a forward-looking think tank for their company, i.e. a group of full-time futurists, experts and researchers who explore all kind of future-related issues not only in the immediate business environment but also in the wider socio-economic, cultural and regional sphere. They have a much wider range of tasks than the observatory, and thus have to be more generalists than specialists. This is not to say that they do not have considerable knowledge in certain areas, but their purpose is especially not to analyse only the developments in their individual fields of expertise but to connect them to a bigger picture of the future.

To fulfil their tasks, the think tanks have build up a global network of experts both from within the company and the outside. Some of them even have established a job rotation or other long-term cooperation with outside research centres or institutes. In any case, however, those think tanks are called upon for many tasks and are widely respected both within the company and outside – and as such, they even conduct foresight activities for selected external clients like major suppliers or customers.

The Heart of Corporate Foresight 'Bringing the outside world in'

Technology foresight is not a well-defined or structured activity in the companies investigated; approximately half the firms reported not having formalized processes at all. Their reasons for this are that foresight activities are neither structured nor linear. In addition a formalization that is too strict would only be counterproductive to their activities.

Nevertheless, the enterprises were unanimous in ascribing to the foresight process at least 4 different phases:

- The formulation of the research question,
- The selection of information resources
- The data analysis, and
- The decision preparation and implementation.

With the latter constituting the interface to the strategic R+D planning and decision-making process. However, most of the interviewed stated that they usually are not the process owner of the last process phase, which is why the study focused on the first three points only:

Determining information needs and core questions: The first decision in the foresight process is whether first to delimit a specifically relevant area of observation of identification of new trends for the search ('inside-out' perspective), and then to start with an oriented search, or to commence the search with a broad, non-limited orientation ('outside-in' perspective) and evaluate the relevance of those search results for the firm in a second step. The enterprises interviewed made use of both approaches in their foresight activities, with the 'inside-out' perspective predominating, since a broad, non-specifically orientated search takes up a lot of time and an „information overload" is fast reached.

The second decision (at least for most of the firms), then is the actual selection of the specific search areas, and the time horizon of the analysis. Here, the firms displayed a wide variety in the foci of their foresight efforts: This is particularly true for the time horizons under observation, which lay between periods as short as 2-5 years up to a period of up to 20-30 years. However, most of the interviewed firms mentioned time horizons between 5 to 15 years.

Differences also became visible with regard to the main thematic areas of foresight: The central focus still is on technology trends on the one hand and market trends on the other. Broader social, political or regional aspects are secondary and are taken into account only by 'think-tanks' or by firms that operate in sectors characterized by a strong societal embeddedness.

The selection of information sources: From the viewpoint of a lot of enterprises, the formation of internal networks and the access to internal information sources is highly crucial for their foresight efforts. This seems to particularly true for futurists in 'collecting posts' who rely strongly on an internal network of observers and experts to provide them with the necessary basic information. Of equal -if not even higher- importance for many firms, however, is to 'bring the outside world in': They put a strong emphasis on the creation and use of external networks as the major source of input for their foresight work. The external knowledge is brought in, for instance, by joint work with external experts, or through participation in professional events or international congresses. In this context an additional source of information is often mentioned by firms operating either in highly market-driven sectors or in fields characterized by a low vertical range of manufacture: Those firms often use their informal contacts with suppliers or customers systematically as sources for information about possible new developments in the markets, mostly in addition to already existing internal or external networks.

In contrast to the cases mentioned before, the last kind of information source is typically of a rather formalized nature - namely, openly accessible future-related information and data which constitute the „classical" sources of trend monitoring, such as patent statistics, and publication analyses or market reports.

In sum, personal information takes a clear predominance over the information that is openly available; likewise a majority of firms consider external knowledge more useful and important for their foresight work than information that is internally generated.

Data processing and analytical approaches: Obviously, the strategic analysis lies at the heart of the whole foresight effort, as only here all the different data and opinions that have been collected are compared, evaluated and interpreted in order to generate future-relevant knowledge. Central to this process step is the choice of the best foresight tools, methods, and approaches for the specific question at hand.

In this context, the interviews showed that in quite a number of firms, rather simple tools predominate: In the field of qualitative methods, this was indicated by the extensive use of cognitive methods like brainstorming-exercises or expert consultations. Typically, these instruments do not demand much preparation or analytical vigour, and thus can be easily employed. In the quantitative field, the same could be said for such simple statistical methods such as patent and publication analyses, benchmarking exercises or market forecasts. Nearly all firms reported to rely on those tried and true instruments for their foresight activities - some of them even exclusively.

Apart from that, however, also more elaborate and sophisticated approached are in use in some of the companies - especially in those with their own future 'think tanks'.

Among those more complex approaches, causal and structural methods like scenarios and simulations are the most common. In addition to that, some firms also conduct their own mini-Delphi and future workshops.

Complementary to the observation above that personal information sources takes a clear predominance over the information that is openly available, there also seems to be a preference for qualitative methods based on the interaction between different internal or external players that are rather person- and communication-orientated. Nevertheless, quantitative instruments are still widely used, albeit in specific areas only.

A Call for Better Cooperation in Foresight

Although most firms in the survey reported to be quite satisfied with their foresight activities, there were still quite some critical points in which improvements could or should be made. The following points were mentioned as problems of the current foresight practices:

- **Methodological problems:** Foresight needs a stronger methodological grounding in order to achieve a greater accurateness of its results.
- **Organizational and managerial problems of the foresight process:** Foresight should never be done for its own sake only but must generate relevant information. Moreover, foresight results have to be better delivered and disseminated to the relevant target groups. Here, it is crucial that the long-term trends and other typical results of a foresight exercise are 'broken down' and 'translated' into present decision options to be of use for the decision-makers.
- **Better overall integration of foresight activities in the company:** Corporate foresight is often too fragmented. There are no centralized offices but a lot of lone hands. It is often too segmented. The activities are too specialized and to uncoordinated to give a complete picture. One way to solve this would be to integrate foresight strongly in the corporate culture, be it via monitoring systems, future workshops, or in mission-vision statements.
- **Better networking, co-operation and consultation between foresight experts:** Corporate foresight experts could profit enormously from the use and exchange of each others know-how, but so far there is a lack of networks of foresight professionals. A better cooperation and consultation between different foresight exercises in different companies or different sectors could save a lot of double work and would provide a broader database for their RTDI-decision-making. The client in one sector is the provider for another sector, and thus one should stronger take into view the whole innovation chain when doing foresight.

Sources and References on Corporate Foresight

The full EU-report including more case studies, the complete questionnaire and a bibliography for further reading has recently been published by the European Commission and can be downloaded at **cordis.europa.eu/foresight/working.htm**

Cyprus 2013

Authors:	Tonia Damvakeraki, Atlantis Consulting S.A., Damvakeraki@atlantisresearch.gr		
Sponsors:	The European Commission ARI – The Agricultural Research Institute of Cyprus		
Type:	The project covered the agricultural sector of Cyprus		
Organizer:	The e-Foresee project consortium ARI - contact Marinos Markou at M.Markou@arinet.ari.gov.cy CKA - coordinator of the e-Foresee project, contact Patrick.Crehan@cka.be		
Duration:	2002-2003	Budget: € 127 000	Time Horizon: 2013

Purpose

The European Commission funded a co-operation project in the framework of the eForesee programme between Cyprus, Malta and Estonia. In this context a pilot exercise entitled "Knowledge management in solving agricultural problems in Cyprus" was conducted. Representatives from the wider public and semi public sector, agricultural organisations and other stakeholders involved in the agricultural process, attended various meetings in order to discuss and express suggestions or recommendations for the improvement of the background paper prepared by the Agricultural Research Institute of Cyprus - ARI eForesee team to facilitate discussions.

Foresight Focus: Sustainable Development in Agriculture

In the case of eForesee - Cyprus, foresight was chosen for the identification of the country needs and potential as well as the most emerging issues in the agricultural sector. Agriculture was selected as the topic of priority due to a number of reasons, among them:

- **Agriculture** and its development were considered as one of the most important in the negotiation process, both for accession states as well as for the EU. Additionally, agriculture in accession countries should be compatible with the Acquis Communitaire and the Common Agricultural Policy (CAP) upon accession,
- Nowadays there is an increased public awareness in agricultural practice and on the quality of products. Sustainable and environmental friendly agricultural practices and products are more respectable and acceptable among consumers,
- The CAP remains always a moving target. Today's CAP is very different from the past and probably will be entirely different in the near future, taking into consideration the situation of the new member states. The tentative goal was to use the 'foresight' tool to propose possible solutions to foreseen problems after accession,
- Negotiations in the frame of the World Trade Organization are expected to affect agriculture.

National Strategies and Goals for the Development of Agriculture

In order to create a national strategy with specific objectives, over a decade, the public sector, farmer's associations, processing units, associations, trade unions and other stakeholders involved in decision making in agriculture, were included in the discussions. Their involvement mainly aimed at promoting sustainability of agriculture and rural development. In order to have a viable development of the agricultural sector it is necessary to have a parallel development of the rural areas of the country. For the achievement of the above, a set of strategic objectives needs to be promoted. Some of these aims are the following:

- Production of high quality and increasingly domestically produced agricultural goods added value in order to improve the competitiveness of such goods on the domestic and international market,
- Employment and affordable living standards for rural inhabitants with less dependence on subsidies, according to the possibilities and limitations of each region,
- Adaptation of agricultural products and production methods, based on the demand/market conditions and technological possibilities,
- Application of environmental friendly production methods and sustainable management of resources, with parallel maintenance and development of the rural areas,
- Protection of the cultural wealth and heritage of every

region, and promotion of the multifunctional character of agriculture, in a way that will benefit the whole society,

- Creation of an economic and social infrastructure, in order to ensure a high level of quality of life for all rural inhabitants; develop the rural areas as attractive places for young people to live and enterprises involved in agriculture to grow in order to exploit local resources and improve the competitiveness,
- Promotion of agro-tourism. Rural areas could be a place for entertainment and vacations for urban inhabitants, with high quality services, especially in the mountainous and less favoured areas, where motivations for enterprises are very limited,
- Promotion of a combination of economic activities in order to achieve an integrated development and minimize the dangers from unpredictable trends (e.g. crisis in the tourist industry).

Inputs from Conference and Pilot Exercises

In the frame of the eForesee project an international conference and two pilot exercises were organised. The topic of the first pilot was: "Improving the competitiveness of Agriculture utilizing modern and alternative production methods", while the second pilot was entitled: "Agriculture as a Knowledge Based Industry".

The aim of the first pilot was to examine ways of "Improving the competitiveness of Cypriot agriculture using modern and alternative production methods". The second pilot started in January 2003 and its main target was to "review knowledge management issues and how they can be used as a tool in developing the agricultural sector".

In October 2003 an international conference was organised. The scope of the conference "Exploring agricultural policy futures for small accession economies in an enlarged EU" held on the 2nd and 3rd of October 2003, was to explore the opportunities and challenges for agriculture after joining the EU.

The conference was addressed to policy makers within Europe responsible for the development and implementation of the National or the Common Agricultural Policy. Main aspects of the Common Agricultural Policy as well as social and economic dimensions of the compliance with the acquis in accession countries were reviewed. There was also a round table discussion devoted to foresight methodology and foresight activities in member states and accession countries.

Foresight was linked to agricultural policy issues in the light of enlargement and the creation of the European Research Area. The final outcome of this Conference was the introduction of alternative strategic visions for agriculture in the post accession period.

The idea was to use that conference to define the major challenges faced by the agricultural sector in the accession countries, and to see how a foresight approach could be applied to tackling problems, which solutions would require a widespread change of perspective, leading to social innovation.

The most important problems recorded during the discussions were:

- Managing the impact of accession
- Meeting the challenge of rural development
- Consolidating and restructuring the former collectives
- Preparing for a sustainable future
- Managing the transition to agriculture as a 'knowledge industry'
- The abolition of farm subsidies

The solution to the above problems could be partly achieved by research and imagination. The rest of the solution lies in implementing political process of building support among necessary constituencies - this is where Foresight can play a role in facilitating social change.

The Lack of Entrepreneurship and The Need for Skills

Cyprus faces a number of obstacles in developing innovation. One of them is the aversion toward entrepreneurial risks. There is also lack of confidence between companies, low level of technological development in the construction industry, lack of specialized workers and a need for new skills. Additionally, economic motivations for research and development opportunities are very limited; there is isolation from EU R&D programmes, fragmentation of the innovation system and lack of institutionalized science-industry-relations.

Research for the Future of Agriculture

The organisation and structure of the government mechanism plays a key role concerning the legislative framework of the agricultural and other sectors of the economy. The responsible authority for the institutional organisation of the agricultural sector is the Ministry of Agriculture, Natural Resources and Environment (MANRE). Apart from the fact that MANRE is the executive body for policymaking, it is also the body that implements the policy through its services. Farmers, as well as their associations and labour unions, are the main recipients of the implemented policy.

In Cyprus the sole body engaged in agricultural research is the Agricultural Research Institute (ARI), a department of the MANRE. With its activities in research, ARI contributes in various ways to the solution of problems related to plant and livestock production and the environment. In the framework of a long-lasting, viable and sustainable development and the improvement of the plant and animal production in Cyprus, the ARI evaluates and implements new scientific and technological methods and recommends new processes and approaches for the rational utilisation of natural resources.

The lack of basic agricultural education, the limited vocational training opportunities and the low level of monitoring and advice provision to the farmers, are the main serious weaknesses that characterize the Cypriot agriculture. In addition, the uncertainty about the sector's future and the social degradation of the agricultural profession have minimised the number of young people who wish to be engaged in agriculture.

Sustainable and Competitive Agro-Economy

The most important policy recommendations coming from the overall process of the exercise are the following:

- A strategic target for agriculture should be based on commonly accepted concepts, reflecting the needs and priorities of the society. In this respect, the strategic target should lie beyond the interests of political parties, pressure groups or other players of the sector concerned. In this frame, a compromise between political parties to ensure strategic legislative stability is of utmost importance.
- The creation of a reliable climate among consumers concerning the quality of the Cypriot agricultural products generally, and specifically of organic products, achieved through a set of controlling mechanisms, is also needed.
- Provisions to create a connecting mechanism and two-way relationship between research and implementation are necessary to achieve competitiveness in the production and marketing of agricultural goods.
- In the frame of the new strategic target incentives to encourage new competent farmers to engage in agriculture, the provision of complementary skills through special training programmes should be introduced.
- Promotion of development initiatives at the regional level could be achieved through the decentralization of services and decision-making.
- In a competitive world the private sector has to play a key role. In this respect, new investments should be protected to foster entrepreneurship in agriculture.
- A high living standard is a prerequisite for a vital rural area. A significant part of public investments should be oriented towards the development of the rural areas in the form of modern services and infrastructure.

Sustainable Agriculture as a Prerequisite for a Prosperous Rural Economy

In an innovation-driven economy and in a world characterized by the emergence of a mosaic of lifestyles and intermixing of cultures, a commitment for continuous learning and the generation of new knowledge have become vital to sustainable economic, social and cultural development.

Future trends and developments are expected to have a direct impact on agriculture and the rural areas of Cyprus, given that they are associated with the Common Agricultural Policy and the World Trade Organization agreement.

Cyprus society requires a strategic target that should be supported by an objective assessment of the international, European and local socio-economic environment toward which the Cypriot agriculture is oriented.

So far there is no direct policy response based on the project results and suggestions although new strategic planning has taken place.

Sources and References

More about the project: www.eforesee.info

Preventative Healthcare Mecklenburg-Western Pomerania

Authors:	Martina Richwien, martina.richwien@ifok.de, Agnes Pechmann, pechmann@dialogik-expert.de		
Sponsors:	Federal Ministry of Transport, Building and Urban Affairs of Germany Ministry of Education, Sciences and Culture of Mecklenburg-Western Pomerania		
Type:	Single issue preventative healthcare		
Organizer:	Institut für Organisationskommunikation (IFOK) Berlin, Inno AG, Karlsruhe und Rostock, Henning Banthien, henning.banthien@ifok.de, Martina Richwien, martina.richwien@ifok.de		
Duration:	2004 to 2005	Budget: € 120 000	Time Horizon: 2015 to 2020

Purpose

The German federal state of Mecklenburg-Western Pomerania plans to increase its competitive capabilities. Mecklenburg-Western Pomerania aligned its research activities in a case study using a regional foresight approach. Considering possible futures is the first step toward influencing today's decision. This is effective through the means of a regional foresight process where the actors are encouraged to build networks and alliances. Accordingly, this foresight served as a means for building competency in Mecklenburg-Western Pomerania related to healthcare.

Mecklenburg-Western Pomerania: a European Foresight Model Region?

Research and development take an ever-larger area within the development of the European Union to one of the most competitive and most dynamic market areas in the world. Strengthening research and development is also an important task for the state of Mecklenburg-Western Pomerania. With the state initiative "Research creates jobs - future for Mecklenburg-Western Pomerania", the state government has developed an instrument to bundle university research with enterprises, focusing on specific medical areas to ensure effective utilization of research results and international positioning. The integration of still single key personnel is needed next to a systematic, long-term approach to achieve the goals and to have a sustainable impact on the structures of research institutes, companies and administration. Regional foresight has been seen as a suitable instrument to tackle these formulated challenges. The Ministry of Education, Sciences and Culture of Mecklenburg-Western Pomerania gave the main impulse to organise such a regional foresight. Parallel the Ministry was represented in a EU working group named UPGRADE. The Research Directorate-General of the EU initiated the working group in December 2003. The working group was concerned with the practical implementation of regional foresight processes. The Ministry of Education, Sciences and Culture could gain the Federal Ministry of Transport, Building and Urban Affairs of Germany as a partner for proceeding regional foresight pilot action.

Focus on Prevention and Health Promotion

Regional foresight is a tool that can be applied to nearly every area, in which changes are expected and aspired, especially if the area under discussion has a strategic importance for the region. The areas of preventive medicine and health promotion show multiple promising activities in the region. Next to the state initiative "MV tut gut" (Mecklenburg-Vorpommern - Mecklenburg-Western Pomerania healthcare economy does good), the state offers international competitive research in the area of preventive medicine. Examples for this are the main research area "Community Medicine" at the University Greifswald or the prevention health research at the University Rostock. Furthermore, the health market is one of the new growth markets. This fact is undisputed in the relevant literature. Beside the increasing therapeutic potential, an important aspect of the health market is the demand for products for holistic health and health promotion. This development was also one of the outcomes of the German national foresight process "FUTUR".

See Foresight Brief No. 1
http://www.efmn.info/kb/efmn-brief01.pdf

The Participatory Approach

Regional foresight can be understood as an enterprise, which integrates elements of future research and future management, strategic planning, networking and participation. It is generally accepted that there is no standard process for regional foresight. Conditions in each region, strategic goals and institutional framework vary too widely. Central elements of foresight processes are described below:

- Issue identification and focusing on specific aspects
- Selection of participants to support network building
- Development of a vision
- Implementation

The regional foresight in Mecklenburg-Western Pomerania started with a pre-determined set of issues to be discussed. Figure 1 shows the working steps of the process.

Participants: The participants for the regional foresight were selected on the basis of a co-nomination process. The readiness and ability for open and constructive co-operation with the partners and the technical authority of the participants were the central criteria in the selection process. All representatives in the sense of the Triple Helix were integrated.

Variables, Vision Building and Key Issues: Global and specific trends related to the sector health and prevention were adapted to the conditions of Mecklenburg-Western Pomerania. Variables were formulated referring both to social and technological trends. They served as the starting point for outlining first pictures of desirable futures. The variables were discussed and contrasted with their attraction and their existing regional competencies. The findings of the discussion were the development of strategic key issues.

Implementation and Focus Groups: To delve into the key strategic areas, focus groups were formed. These working groups took up the most attractive key issues and developed them further. In interdisciplinary discussions, the participants compiled strategies and concrete recommendations for action to convert these visions into real life.

Network Building and Communication: The work of the focus groups consistently required inclusion of the overall context and a discourse with decision makers not included in the direct process. Two special committees of the foresight initiative were responsible for this integration activity.

The first committee, the steering committee, played an important role for the supra-regional anchorage and communication. The committee consisted of recognized personalities with high integration traits. The second committee, the strategy committee, formed the content and strategic roof of the focus groups. Further communication instruments like public meetings for back feeding the results to policy makers or publishing brochures for the diffusion of results were especially designed for the project.

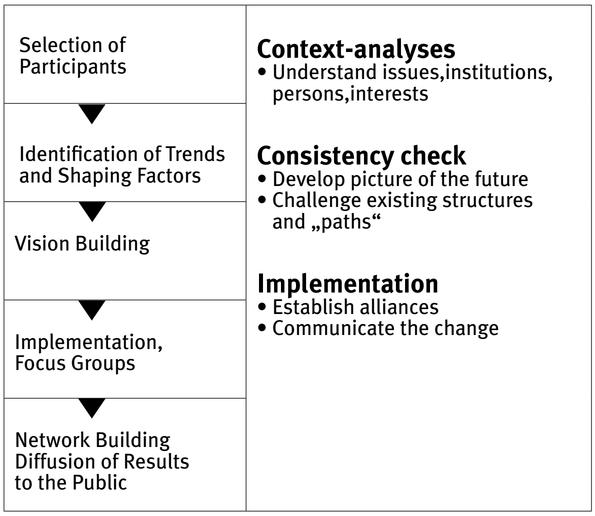


Figure 1: Process scheme

Key Topics – Challenges and Opportunities

Relevant trends in the field of medical prevention with importance for and impact on Mecklenburg-Western Pomerania like the stronger role of prevention in medical care, the development of new services and new products (self payment), the further development of patient rights and technological drivers were discussed. The following scheme gives an overview of the trends and variables discussed.

Prevention in the field of medical care	Obligatory prevention programs¸ new organisational structures, new evaluation methods of medical treatment, virtual partnership etc.
Consumer behaviour and new services	Holistic services, additional medical needs (fitness, nutrition), patient as customer (marketing and certification), etc.
Technological drivers	Regeneration and cell therapy, new systems for diagnosis, E-health, etc.

Figure 2: Examples for discussed shaping factors

Identification of important key issues for Mecklenburg-Western Pomerania in health prevention was based on a discussion of the relevant trends and key factors and the already existing regional strengths. The following seven key issues were identified:

- Regenerative medicine
- Community medicine
- Integrative prevention
- New integrated care structures
- Health education
- Drug prevention
- Screening activities

Three out of the seven key topics were then addressed further, compiling a more detailed picture of the future and specifying recommendation for action.

Regenerative Medicine

Regenerative medicine describes the research committed to the reestablishment of malfunctioning cells, tissue and organs both by biological substitution, e.g. by in vitro cultivated tissue, and by stimulating endogenous regeneration and repair processes. Molecular-biological basic research, material science, biotechnology, chemistry and applied medicine need to be combined for this research. A substantial goal of regenerative medicine is to eliminate and/or to avoid various problems of the transplantation medicine and to open new perspectives with the regeneration of tissue, so far not accessible for transplantation. That includes stem cell transplantation. The goal of the focus group “Regenerative Medicine” was the creation of a scientific and clinical network, which would serve present needs and would support as well the building of a social network. Partners of this process were the research institutes with its scientists, companies based in Mecklenburg-Western Pomerania, local health organizations, hospitals, technology transfer organisations, venture capitalists, start-up companies, actors from education and information. Workshops and other meetings, even on international level, achieved the goal by establishing new partnerships between the actors and policy involved. In addition, epidemiological studies were included, whereby a connection to the Community Medicine was made.

Community Medicine

The focus group “Community Medicine” worked on a flexible access to healthcare and prevention in the rural area. Healthcare access structures, considering the increase of the age-conditioned diseases, must be adapted. This concerns a healthcare access centre, which is connected via tele-medicine to the university clinic Greifswald. This means health-related activities: Services and systems are performed remotely by means of information and communication technology. It serves health prevention, disease control, healthcare services, and is beneficial for training, management and research in the health sector. The training and the employment of a “community nurse” is a central point of the new health access concept putting major emphasis on preventive actions in the domestic range. She supports the physicians in the region in their obligation to ensure health access. Other tasks are to determine the risk potential in households, to examine reciprocal effects of medicines and to accompany the support by tele-medicine. Another topic of “Community Medicine” addresses health prevention on the basis of lifecycle models. In different phases of the lifecycle, health prevention is to be carried out in the direct living environment of people. For each phase of the lifecycle it has to be clarified what form of prevention with which activities are reasonable and cost-effective.

Integrative Prevention

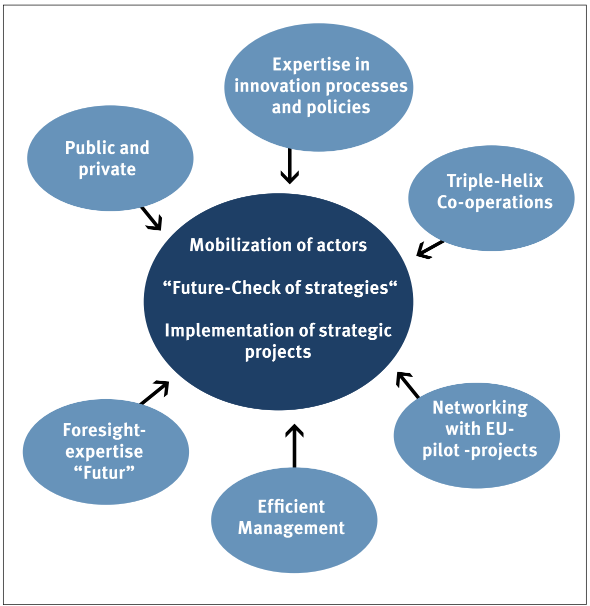
The focus group “Integrative Prevention” had the goal to initiate a Center for Integrative Prevention (CIP). Under a holistic approach, not only clinical medicine, but also non-medical fields were included. International and interdisciplinary networking took place. Renowned research institutes worked together with partners like insurance companies, hotels, fitness centres or rehabilitation hospitals. In the CIP, patients, employees, tourists and others interested are to be examined regarding their physical fitness. Aspects of grouping according to certain criteria are to be analysed and aspects of occupational medicine would be addressed. This work is to be accompanied by several research projects.

Effective Communication with the Public

Foresight is often used as a means for communication, since the process enables to loop back to the discussion in politics as well as to the one in and with the public. In the case of this foresight process, events with lively public response were held with discussions about political, economic and institutional parameters of a future healthcare economy in Mecklenburg-Western Pomerania.

The Social Dimension and other Success Factors

The regional foresight process of this study has been designed as a pilot action and as a case study to demonstrate and to verify the foresight process as an effective tool of innovation policy. The scope of this foresight process was determined prior to the start. The duration was 15 months and the spectrum of the topic was restricted to health prevention as one of the core competencies of Mecklenburg-Western Pomerania. The restriction on this topic has proven sensible for at least two reasons. First the outcome of the pilot process could be related to the outcomes of the national foresight process “FUTUR” and second it was possible to bundle resources.



Foresight is a tool to support long-term planning. The “Blueprints for foresight actions in the Regions UPGRADE” recommend three years and minimum runtime for regional foresight processes considering that economic perspectives are implemented over the long run. It also needs time to strengthen the social capital by increasing the capability to form networks and by co-operation capabilities. Research politics and economic potential are evaluated under mid- and long-term perspectives. With this in mind, the presented results need to be reviewed. (Figure 3)

Success Factors Identified

In the foresight process several success factors were identified (see. Fig. 2). The participation of the relevant actors of the innovation system of the Triple Helix was a main success factor. The reflection of possible future activities can only be as good as the expertise provided. Hence it was necessary to search for expertise on a broad base with no restriction to the region and, then to integrate this result with the competency in the region for optimum stipulation. The support from political decision makers in the state and catching up with international know how and developments were important success factors. Important, as well, was the experience introduced from other foresight processes, and the efficient management of the process. Tasks such as time and resources planning of the social dimension next to the project management were vital. During the whole process enabling a culture of learning and feeding into the learning process as well as supporting a culture of change had to be ensured.

Recommendations

So far, the foresight process was successful and the results can be valued as positive. The motivation and the participation of key actors were extraordinary. In addition, the successful implementation of first actions like the community nurse and the concept of integrated health access were vital. Since the guiding vision was described only in main streaks, it is desirable to develop the vision to a full-fledged version to have its full potential unfold. Given the limited time frame, the results of the pilot action can be viewed as very successful. Therefore the recommendation can be given to further advance the regional foresight activities in Mecklenburg-Western Pomerania and broaden the thematic spectrum.

Sources and References

Entrepreneurial Science: The Second Academic Revolution, in: Etzkowitz, H./Webster, A./Healey, P.(eds.) 1998.

Capitalizing Knowledge. New Intersections of Industry and Academia, Albany, SUNY Press: 21-46

Heinze , R.G. et al. (2006) : Masterplan Gesundheitswirtschaft Mecklenburg-Vorpommern 2010 im Auftrag des “Kuratoriums Gesundheitswirtschaft Mecklenburg-Vorpommern”. Bochum/ Gelsenkirchen.

Linz 21

Authors:	Beate Schulz-Montag / schulz@z-punkt.de, Dr. Karlheinz Steinmüller / steinmueller@z-punkt.de		
Sponsors:	Administration of the City of Linz, Austria		
Type:	Municipal foresight exercise		
Organizer:	Ars Electronica Center Linz Museumsgesellschaft mbH, Dr. Christa Schneebauer, info@aec.at Z_punkt GmbH The Foresight Company, Klaus Burmeister		
Duration:	2002-2004	Budget: n.a.	Time horizon: 2013 to 2018

Purpose

The "Linz 21" project was an ambitious attempt to describe future development paths for the Austrian city of Linz. Its purpose was to enable active design of the city's future in the 21st century, cognizant of the manifold challenges the municipality now faces. The process was designed for public participation. Several exploratory scenarios were developed in the period from 2002 to 2004. Those scenarios depicted the effects of various action alternatives and supported active and successful strategy development.

Why Did the City of Linz Require Futures Scenarios?

The great complexity of the city's social and economic fabric together with rapid change, accompanied by increasingly intense competition, imposes enormous challenges on today's society. The Austrian city of Linz thus recognized the need to undertake analysis of possible development vectors in order to survive in the competition for quality of life and economic strength over the long term. Here it was necessary to take account of interactions and to use the knowledge thus obtained when developing futures strategies.

This was the background against which the Linz City Council issued a directive and contracted out scenarios describing the potential futures relevant to the city, covering the coming ten to fifteen years. The initiative started in October of 2001. The scenarios were to be used as landmarks for a broad-based discussion on the city's future and guideposts for the city's activities.

The Scenario Process

Participants
The City Council initiated a participatory process in 2002. More than eighty experts from government and public administration, from the business community and from society at large took part. Ars Electronica Center Linz and Z_punkt The Foresight Company were in charge of the methodic and conceptual supervision.

Course of activities
Owing to the multitude of influencing factors and the complexity of the tasks, a three-phase procedure was adopted for the development of the Linz scenarios.

Six central topic areas were first selected and several "rough" scenarios (so-called sub-scenarios) were sketched out for each of these areas. In a second phase these rough scenarios, referenced to specific topics, were brought together to create global scenarios for the future of Linz. In a third phase, the global scenarios were adapted and refined in respect of each topic area.

		PROCESS LINZ 21
2004	May-July	Feedback round with public participation
	March	Final Report
2003	Nov.-Dec.	Revision
	4. Feedback Round	
	June	Fusion of detail scenarios to 4 refined scenarios
	3. Feedback Round	
	April-May	Enrichment of sub-scenarios on the basis of gs-outlines
	March	Reduction of scenario sketches from six to four
	Jan	Workshop, all alarms (Result: six global-scenario-sketches)
2002	**2. Feedback Round**	
	Nov.-Dec.	Construction of specific sub-scenarios in working teams
	1. Feedback Round	
	Oct.-Nov.	Development of trendsheets and key factors in working groups
	Sep.	"Method Toolbox" by Z_punkt
	June-Sep.	Formation and coordination meeting of the working groups
	June	Establishing of the Future Council
	May	Contract "Our Future: Linz 21"
2001	Oct.	The Linz City Council issues a directive to work out future scenarios

Figure 1: Outline of the process

The three phases, seen in detail, were as described above.

Linz seen from a national, and global perspective ...

A group of experts ("project sub-group") was designated for each of six subject areas:

- Education, science, research, innovation, technology and development
- Efficiency and efficacy of municipal service providers
- Arts and culture, athletics, recreation, information and the media
- Health, social affairs and promoting social involvement
- Business, labor market and tourism
- Residential issues, traffic and transit, urban planning and development, and inter-municipality cooperation.

These project sub-groups first complied, systematized, and described the most critical trends and developments affecting the city of Linz and its national, European and global setting in each of the six subject areas. Using this collection of trends as a basis, "key factors" were identified for the several topic areas. These trends will have a decisive effect in the near future.

Since these key factors also harbor considerable uncertainties, each project sub-group drafted, in a workshop, three sketch-like scenarios for its topic area. The basic question here was, "Which potential future developments in certain key factors dovetail with potential future developments for other key factors?" To answer this question, each of the groups conducted a consistency analysis with the aid of the "morphological box" where cross-consistencies in the various embodiments of the key factors were sought. It was on this basis that sub-scenarios specific to the particular topics were identified. These sub-scenarios later formed the starting point for the construction of the global scenarios.

From global scenarios ...

In January 2003, the results of the project sub-groups were merged to form a "unified whole". This was done in a large scenario workshop attended by more than 80 persons drawn from government and administration and public life. The 6 × 3 = 18 topic-specific sub-scenarios were amalgamated to create four global scenarios which describe the alternative blueprints for Linz in the next ten to fifteen years.

The global scenarios were first formulated with software support, using the interaction matrix method. At the scenario workshop the members of the project sub-groups then had the opportunity (in working group brainstorming sessions) to examine the global scenario outlines (the output of the scenario software), to introduce corrections and modifications where appropriate and indicated, and to augment the substance.

To refined scenarios.

Once the global scenarios were available in draft form it was necessary to make them more specific and concrete and to enrich them so that in each case they offered a descriptive and detailed picture of Linz at the beginning of the 21st Century. These scenarios then served as the basis for a discussion on a desirable future for the city. At the same time, the topic-specific sub-scenarios were enhanced – against the background of the global scenarios – and made more precise. Thus they were further refined to form substance-rich, adapted and detailed scenarios. This was affected through intensive feedback in the project sub-groups and with the project team. Both – the more concrete global scenarios and the topic-specific detailed scenarios – were ultimately boiled down to create four detailed scenarios for the future of Linz:

- **Cooperation and participation**
- **Disjointed knowledge society**
- **Concentration on the essentials**
- **New values in the urban sphere**

Figure 2 shows the context of detailed scenarios and global scenarios (morphological box)

Possible Futures of Linz

The four alternative scenarios for Linz are described in brief below. The detailed scenarios, including the individual topics and trend analyses that went into the scenarios, are contained in the final report. It can be obtained free of charge at the Internet address cited below.

Scenario 1: Linz as a functioning metropolitan area

Working under the title "Cooperation and participation", the focus was on the Linz metropolitan area. It proved to be a region with common interests, unified and requiring cooperative arrangements to the extent that adjacent municipalities are joined primarily by complementary or reciprocal relationships like e.g. housing, employment, and shopping locations. They are also interested in exploiting the synergies of common policies in the region they share. This boosts economic power in the region. The resultant additional revenues can be used to finance investments in sustainable development for "Linz and its environs", particularly in the fields of traffic and transit, health and social affairs.

The major opportunities offered by this scenario are improved options for governing the "soft factors" such as recreational and sports facilities within the conurbation. Problematic in this scenario is the extremely complex and complicated implementation of a metropolitan area that actually functions. There is reason to fear that efforts in this direction might slowly stop at the halfway point or not even progress beyond the "groundbreaking" stage.

Figure 2: Context of detailed scenarios and global scenarios (morphological box)
The four alternative future images for the City of Linz were presented to the public in the spring of 2004.

Scenario 2: The knowledge-divide

The "Disjointed, Knowledge-Driven Society" scenario observes the trend toward increasing significance of knowledge and innovation; it describes a city in which education and research are massively supported. Primarily an alliance of businesses, academic and extra-academic research institutes, and innovative, "future-motivated" citizens and workers will drive economic development in Linz and its metropolitan area. This will give rise to a climate of dynamism and flexibility in all the knowledge-driven industries. Public administration will embrace this definition of the focus but otherwise will withdraw to its core activities – with all the unfavorable impacts on traffic and transit development, health and social welfare for the populace.

The major hazard involved in this scenario is thus the creation of a "two-thirds society" wherein the knowledge-driven society – to the extent that no political countermeasures are launched – will indeed tend to widen the gap between "rich and poor". However, it will not be the sole cause of the increasing divergence within the populace.

Scenario 3: Limited public services and devolution

"Concentration on the essentials" takes as its starting point the thesis that the City of Linz and its administration – ultimately being forced to do so by budgetary constraints – will focus on its core tasks. Given this perspective, local government sees itself primarily as the guarantor for basic public services. It creates the appropriate framework for their delivery. It concentrates on governing public services and on quality assurance wherever market mechanisms fail. Raising efficiency and reducing expenditures in the city budget are in the foreground here. In some cases, this situation creates greater clarity; focal points in cultural activities might be made clearer. The city foregoes delivering the full spectrum in arts and culture. The individual bears greater

	"Concentration on the essentials"	"Disjointed knowledge society"	"Cooperation and participation"	"New values in the urban sphere"
SPG 1 detail scenarios	"Linz as a functioning metropolitan area"	"Linz as a functioning metropolitan area"	"Citizen-friendly active city"	"Citizen-friendly active city"
SPG 2 detail scenarios	"Crisis as a chance"	"Linz- a research-development and education-base with intern. significance"	"Linz- a research- develop-ment and education- base with (inter).nat significance"	"New values-new science"
SPG 3 detail scenarios	"Daring the gap"	"Open knowledge-society"	"Regionality as a concept"	"Regionality as a concept"
SPG 4 detail scenarios	"Reactive scenario"	"Two-tier society"	"Proactive scenario"	"Proactive scenario"
SPG 5 detail scenarios	"Active economy"	Active economy"	"Central region"	"Parochial thinking"
SPG 6 detail scenarios	"Suburban sprawl" syndrome, Variation 1"	"Sub-urban sprawl" syndrome, Variation 2	"Sustainable city design"	"(Re-)Discovery of the urban space"

responsibility in, for example, the fields of education, in preventive healthcare etc. The suburban area around the city is taken to be set and accepted – with all the consequences for traffic and transit and the infrastructure.

Thus in this scenario there is the hazard that the municipality, as a result of excessive outsourcing or reducing too severely its own options for designing the future, will experience a sharp loss in political influence. Consequently critical sectors are allowed to "drift along on their own", without any government intervention.

Scenario 4: Multiple cultures and diversity

In the fourth scenario – "New values in the urban sphere" – urban flair is coupled with an inspiring and uplifting "multi-cultural climate". Here local government will deliberately support and promote elements of urbanity – such as cultural diversity, multiple city centers, ample traffic and transit infrastructures, generous and innovative architectural and urban planning. Over and above that, the strengths of this scenario are to be found in consciously narrowing the opportunity gap between men and women and, more generally, fostering measures to activate the resources in the populace. In the healthcare sector, for example, there will be an emphasis on preventive medicine.

Enabling and guaranteeing the acceptance of diversity (key words here being immigration and integration) – in economically unsettled times, as well – is a crux of this scenario. A further risk is that Linz will indeed succeed because of other traditional and well-established site factors, but at the same time, it will neglect other sectors associated with (new) technologies. In its strong concentration on itself and its own qualities Linz could "miss the boat" on international development.

Mission Statements Still to be Formulated

Scenarios and trend analyses were worked within the framework of the project "Our future: Linz 21". They are suitable for sharpening our senses and pointing out relevant parameters in potential developments. They present ranges for action and, as regards to the approach, are explorative in nature. As such, they can be used to depict plausibly the effects of action alternatives and thus serve to support active, sustainable strategy development.

The present scenarios can include only a finite number of measures and concrete examples. To give the residents of Linz an opportunity to embellish the scenarios with their own new ideas, critical comments and creative additions, the city administration has made the scenarios available to the public via the Internet.

The people of Linz thus have an opportunity to question the existing "development proposal", to examine the relevance and plausibility of the scenarios introduced, and to filter desirable developments out of the sum of all those possible. The objective is to derive, from the various futures scenarios, orientation for individual policy and design fields and to formulate a mission statement for municipal action.

Sources and References

The entire process, including all the reports, has been posted at the City of Linz website: **www.linz.at/linz21**

The Future of Design

Authors:	Werner Reutter / werner.reutter@rz.hu-berlin.de		
Sponsors:	European Union, Land Northrhine-Westphalia City of Essen		
Type:	Overview brief		
Organizer:	Zollverein Essen and Zeche Kohlenwäsche / info@entry-2006.com		
Duration:	2006	Budget: n.a.	Time Horizon: n.a.

Purpose

New technologies will radically alter both the future of design and the design of the future. While design used to be a means in order to bring the very essence of given objects - mostly products, to the fore - "form follows function" -, bio-, nano- and information technologies will enable designers to interfere into the foundation of life and nature. In consequence, the possibility to design Bits, Atoms, Neurons, and Genes (BANG-Design) will trigger a convergence of design and science and lead to yet unknown ways to design objects and products.

How Will We Live Tomorrow?

"Entry2006" and "Entry Paradise" are previews on the convergence of design and technology describing the beginning of design by exploring the role of the first designers and running through the history of design. It then examines modern design and the role of cult brands. But most importantly, it previews future developments, the risks and chances that new technologies might provide for design.

These previews are the more important as the art and the profession of "design" are facing a paradigm shift. Originally, a design was to serve the function of an object - mostly products. The mantra of this approach was: "form follows function".

However, new technologies enable designers to intervene into nature and to radically alter the way we live and shape our surroundings. Designing is no longer just a technique to enhance and bring functions of objects better to the fore. But due to new technologies design can create and sustain emotions, social relations, or even change the nature. As a matter of fact, in the future it might be feasible to "design" modules of our very existence, i.e. our bodies, landscapes, houses and cities. In addition, the objects of design can be invisible due to the use of nanotechnology. Overall, this raises not only technological questions, but also social, political and philosophical ones.

"Entry2006" and "Entry Paradise" are neither forecasts in a traditional sense nor do they claim to predict a specific future. Rather, they can be understood as an interdisciplinary approach that combines artistic visions with an exhibition, political debates, and scientific discussions. In consequence, a number of disciplines were involved in this project: e.g. design, history, social sciences, cultural studies, philosophy.

The overall goal of the project was, hence, less to predict specific developments or provide policy recommendations – even though there are some included – but rather to describe artistic visions, to increase our understanding of changes and raise our awareness about the risks and opportunities new technologies may create for societies in general and design in particular. The brief reflects this unorthodox approach. It attempts to highlight some crucial dimensions of this project.

Disconnecting Form from Function

In a recent movie entitled "The Devil Wears Prada", Meryl Streep plays the merciless and extremely bossy even cruel chief editor of a fashion magazine. In a short scene Meryl Streep tells her poorly dressed assistant, who regards fashion as unimportant, the history of the pullover the assistant is wearing. Streep tells her stunned assistant that the colour of the assistant's pullover goes back to a decision made by a fashion designer a number of years earlier. The colour, an undistinguishable blue, was copied by others and eventually used for the cheap pullover the assistant had bought in a junk store somewhere. But by picking that pullover the assistant made a statement. What she was saying was: I am too important to be bothered with fashion or the way I am looking. That is what the pullover was telling. Yet, as Streep points out, the assistant is wearing a pullover with the undistinguishable blue because fashion designers have decided so.

This little story reflects the conflicting demands contemporary design has to meet. The design of an object has to be original, individual and fit for mass production (Jan van Rossem, journalist for Architektur & Wohnen) at the same time. In addition, the example points to the fact that form and functions of design are not necessarily connected any more. Form and design have acquired a value of their own. As a matter of fact, very often the design or the brand of an article is more important than the function of an object.

As a profession design came into being as an effect of the division of labour and of industrialisation. These roots have defined the character of design in its early stage. I was a skilled craft rather than an art not to mention a science. A design was to serve the functions of an object - mostly products; it was an auxiliary aspect that was supposed to bring the essence of things to the fore. Consumerism and mass production have changed these basic tasks. Nano-, bio-, information- and communication-technologies will alter design once again.

New technologies and social change have triggered a paradigm shift of design. Design tries to create emotions, thus focusing less on objects rather than on relations. Even more importantly new information-, nano-, and biotechnologies will radically alter the nature of design. The objects of design - bits, atoms, neutrons and genes - will be different as well as the methods and the goals of design. This paradigm shift has led to what has been coined BANG-Design.

BANG-Design

In BANG-Design two developments are meshed together: On the one hand the aforementioned paradigm-shift in design. Design has itself emancipated from objects. On the other hand design has to manage the movement toward converging technologies (Norbert Bolz, Communications Departments, Technical University of Berlin). It twill be the major challenge for designers in the 21st century to manage these processes of convergence.

BANG is the acronym for: Bits, Atoms, Neutrons, and Genes. The fact that we are able to analyze and manipulate the constituent modules of our physical environment (including our bodies) the very foundation of designing is put into question. Design can produce emotions, it can create products - “food design”, and it even can form bodies - “body design”. Norbert Bolz even argues that the co-evolution of technology and society will lead to socially intelligent and convivial technologies.

In a way BANG-Design has to transcend nature. Bio-Design will enable us to create a perfect environment, which Bolz coined: post-humane paradise. Norbert Bolz even goes further and sees four dreams of mankind in the reach:

- Understanding: User-friendly interfaces are becoming a necessity; designers have, hence, to create new possibilities of communication and networking.
- Creation: We are able to use new materials for clothes, houses, cities, food etc. We can add molecules to existing materials thus enhancing functions of objects like in clothes with new materials etc.
- Immortality: The idea to remain forever young has become widespread. And we already have the technologies to come closer to this idea by manipulating genes, by undergoing plastic surgery etc.
- Security: Western societies are facing new threats that produce an increasing demand for security. At the same time western societies are less inclined to sacrifice people for their protection. Hence, warfare will become more technical and virtual. Robots, un-staffed airplanes are logical consequences as well as a dense network of supervision and control.

The Beauty of Designs and the Economy of Products

Some understand beauty as the opposition of meaning and purpose because real beauty serves no function - like a field of flowers. This postulate has shaped and determined the tasks of design for a long time. Design had to support the economic success of objects not to mention the fact that the first designers were to provide prototypes that could be copied by the workers. However, nowadays designers also attempt to make objects more beautiful regardless of functions or economic necessities. This is partly a reaction to cultural shifts in society but also a consequence of the possibilities of new technologies.

In the past we already tried to improve the “design” of our selves by picking a certain hairstyle, by sticking to a specific fashion brand or by having cosmetic surgery. In the future biotechnology and the result of genetic research will provide an exponentially increasing number of choices and possibilities in this respect. Some see in these developments reason for hope because genetic research may give us the means to overcome diseases or discover resistant plants. Some rather fear the negative consequences of this kind of scientific progress.

Mutants of Objects of Design

Ulf Poschardt, a pop journalist, discusses the ramifications of such developments. Yet, he disregards the existing cultural norm that the genetic status quo of human beings should not be altered. Thus, he raises the question: How would society deal with yet unknown forms of humans? As there are no "scientific" studies that would give an answer to this question, he looks at the way contemporary art has addressed this topic and he especially deals with mutants.

Mutants are a common topic in movies, comic strips, paintings, or other products of art. E.g. in the movie Blade Runner mutants are seen as a threat because they look exactly like human beings. Yet, men created them. In another movie, X-Men, mutants are a next step in the evolution of mankind. In X-Men mutants are able to use the whole range of their DNA. They develop superhuman powers and capacities. In this movie the difference between mutants and human beings are described as a battle for domination fuelled by fear and anxiety. According to Ulf Poschardt due to biotechnology and genetic research such evolutionary leaps may well be possible. It will then be the task of designers to bridge the gap between the anthropocentric and humanistic thinking of our time and a world that knows other forms of existence.

The realistic potential of artistic or cinematic visions is shown by the fact that genetic research is more and more able to design the very modules of human life: i.e. cells (Frank Edenhofer, stem cell engineer, University of Bonn). For example it is possible to "enhance" embryonic stem cells by adding hormones or other extra cellular signals. Thus, in principle, it would be possible to predetermine eye-colour, intelligence etc. of a baby.

The Coming of 'Next Nature'

Similarly, we used to think of nature and culture as two separate things (Koert van Mensvoort, media artist and researcher). However, mankind has more and more conquered nature in the sense of plants, animals and climate. One can even say that nature has turned into a culturally defined environment created and shaped by men. We restore nature like forests, lakes and parks, based on the image we had built about it. Nature has become a cultural category or something what Koert van Mensvoort called "next nature".

'New Organic Design'

Similar effects can be found in "new organic design" (Ellen Lupton, Cooper Hewlitt Museum, New York). This type of design uses e.g. human "skin" as a sort of blueprint in order to create innovative materials and surfaces. Human skin is a very complex and sensitive material. Objects with a skin-like surface react to light and temperature and can convey information. Yet, these qualities are the reason why designers use these new materials. Such developments also point to the fact that the boundary between technology and nature is disappearing. While skin has become a commercially produced object, the objects and buildings with skin as a surface become similar to natural organisms.

Space and Communication: Houses and Cities

It is just a commonplace to state that information technologies have altered our way of communication. Architects and designers also start to use these technologies in order to redefine houses or reshape cities and landscapes. For example, the concept of an "open house" tries to overcome our way of living (Jochen Eisenbrand, curator, and Alexander von Vegesack, Vitra Design Museum, Weil am Rhein).

While smart homes are still limited to predetermined options like regulating the temperature, the light etc., an open house adapts itself to the user and the needs of the user. It is assumed that computers will be integrated in our surrounding and they will be able to communicate with each other. This will lead to an "ambient intelligence". In an "ambient intelligence" remote controls like personal digital assistants would be superfluous because sensors in the walls or the floors or fixed at persons would allow the system to identify our whereabouts and our movements. Based on this information the system would automatically adjust temperature, light etc. This would also include to what has been coined ubiquitous computing. Instead of having a single computer all the objects in a house would be enhanced by computers.

Other ideas try to use information technologies to redefine the boundaries between private, public - e.g. parks - and commonly used spheres. In a project called Seoul Commune 2026: Rethinking Towers in the Park the idea is pursued that our private space - bedroom, bathroom - is reduced, while the occupancy of our commonly used space - e.g. living room, kitchen - is organized by information technologies. We would book these rooms in advance and then be entitled to use them for the time we made the reservation.

The project Megahouse goes even further. It is an attempt to better use existing space in a city. It is a sort of improved and complex timesharing system: Offices or other rooms that are not used in a city can be booked online. The access to this space would then be limited to the person in question and biometric scanning could control it. Both projects would, however, presuppose a totally new understanding of property and privacy.

Warnings against State Interventions

The goal of the project was not to come up with some concrete policy implications or forecasts. It was rather an attempt to describe possibilities or visions, even though many of them seem still highly unrealistic. Nonetheless, such an approach helps to increase our awareness about possible developments and describe opportunities new technologies may provide for designers.

However, the project also included some sort of risk assessment. Bill Joy, a pioneer in computer technology and programming, saw notably two dangers: First, in a foreseeable future we will produce computers that will be far more powerful than the PCs we actually use. We will have robots and “nano-robots” that will dispose over complex intelligence and will be self-managing. However, in this case the machines don’t need mankind any more. In consequence, Joy fears that we risk of being extinguished by computers. Second, even a small group of men can use new technologies for a terrorist attack. While formerly rare raw materials or large-scale equipment was necessary, nowadays just technical skills are required to launch an attack on a country.

Yet, in spite of these risks Joy argues against state intervention. Public regulations and laws would not only be ineffective, but they would necessarily infringe upon our civil rights and limit the private spheres. In addition they would lead to an immense apparatus that would have to supervise us. Hence, Joy asks for a sort of self-limitation. Researchers and computer specialists have to become aware of these risks and abstain from developing technologies that might eventually endanger the human race.

Sources and References

The articles referred to in the brief can be found in Gerhard Seltmann/Werner Lippert (Hrsg.): Entry Paradise. Neue Welten des Designs, Basel etc.: Birkhäuser Verlag für Architektur 2006.

Ambient Intelligence 2020

Authors:	Olivier Da Costa / olivier.dacosta@m4x.org Michael Friedewald / Michael.Friedewald@isi.fraunhofer.de		
Sponsors:	The European Commission DG Joint Research Centre ESTO – The European Science and Technology Observatory		
Type:	Sector specific Foresight		
Organizer:	The IPTS - Institute for Prospective Technological Studies - in Seville		
Duration:	2002 - 2003	Budget: € 200 000	Time Horizon: 2020 and beyond

Purpose

The "Ambient Intelligence in Everyday Life" or AmI@Life S&T roadmap was developed within the IPTS of the European Commission's Joint Research Centre in collaboration with ESTO - the European Science and Technology Observatory network. It addresses the potential of universal and trusted access to Ambient Intelligence technologies and the functions in everyday life, raising the issue of universal access to new technologies and functions. The methodology of technology roadmapping was adapted to R&D policy intelligence by implementing a "function-oriented" approach intermediate between technology-push and user-pull. This approach has provided fruitful ways of thinking about useful, accessible and trustworthy functions.

IPTS/ESTO S&T Roadmapping

The "IPTS/ESTO Science and Technology Roadmapping" project was set up to address three main questions:

- What are the major societal challenges facing Europe?
- What are the emerging technological responses to these challenges?
- What are the pathways between these challenges and responses?

Its main objectives were to inform research and development policy at European level through a series of problem driven technology roadmaps. The activity also sought to review and develop methodological approaches to mapping research and technology. Two pilot maps, "Ambient Intelligence in Everyday Life (AmI@Life)" and "The delivery of Healthcare in the context of an ageing society," were completed.

Ambient Intelligence Vision

"Ambient Intelligence" (AmI) refers to a vision of the future information society stemming from the convergence of ubiquitous computing, ubiquitous communication and intelligent user-friendly interfaces as envisaged in the ISTAG (Information Society Technology Advisory Group) Scenarios of Ambient Intelligence in 2010 (ISTAG 2001). It puts the emphasis on user-friendliness, user-empowerment and support for human interactions.

Will AmI Reach the Masses or Just the Niches?

AmI is more a vision of the future than a prediction. It is per definition normative and portrays a desirable future. By putting a major claim on being people-oriented, it also assumes that AmI will potentially be inclusive, providing of course it delivers up to its promises of being user-friendly, unobtrusive and controllable. But even if these promises are met, the fundamental question remains open if AmI will be able to include a majority of people by delivering effectively useful, accessible and trustworthy innovative functions. If this is not the case, it will benefit mostly the young, urban and mobile techno-freaks thereby becoming an additional source of exclusion in society, also referred to as the "digital divide". It is the concern of policy-makers to influence the ongoing evolution towards more cohesion and inclusiveness or at least to mitigate some of its negative effects.

Scope of the Roadmap: Everyday Life

AmI@Life was scoped towards everyday life outside the professional sphere. Indeed, there seems to be no simple spillover of technologies from the office to the home. Six major application areas were considered as representative of everyday life:

- Housing, Mobility and Transport,
- Shopping and Commerce,
- Education and Learning,
- Culture, Leisure and Entertainment as well as
- Health.

Identifying key functions where AmI could "make a difference" made the linkage between technology developments and users.

The "Function-oriented" Approach

Traditional technology roadmaps tend to focus on the development trajectories of technologies to provide new products - Corporate TRM - or on detailed enabling technologies in the pre-competitive domain - Industry TRM. Within the AmI@Life roadmap, the methodology of technology roadmapping was adapted to R&D policy intelligence. A "function-oriented" approach was developed as an intermediate way between the technology-push and the user-pull approaches.

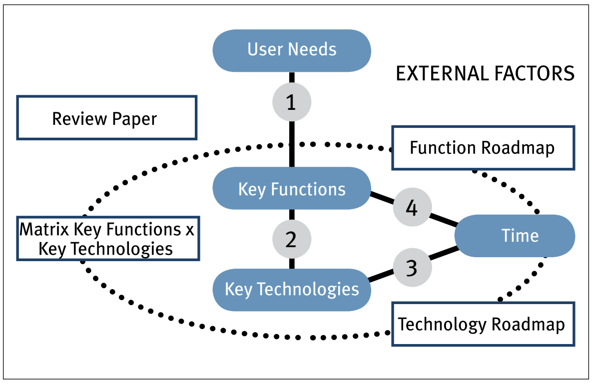


Fig. 1: The "function-oriented" approach

The main feature of this approach consists in crossing "key functions", "key technologies" and "time" two by two. See figure 1:

- Scanning of the application areas in order to identity key functions.
- Identification of the key enabling technologies needed for the development of these functions. Since Ambient Intelligence is a true cross-cutting vision the development of practically all ICT have been considered.
- Mapping of these key technologies over time. The "technology roadmaps" synthesise the time horizon of the necessary technological breakthroughs and the critical bottlenecks.
- Mapping of the key functions over time by integration of the two previous steps. The "function roadmaps" synthesise the major milestones, potential breakthroughs or disruptions, critical paths for the developments of key functions and alternative scenarios.

The identification of the functions, technologies and the timelines were derived from a careful and iterative process of analysis and synthesis of previous works and from brainstorming.

Technology and Function Roadmaps

The main outcomes of the study consist of detailed graphical representations of functions which "will make the difference" for AmI in everyday life - "function roadmaps" - and of key technologies indispensable for the development of the former - "technology roadmaps". The time scale reaches from 2005 to 2020 and beyond. Colour codes are used to indicate the uncertainty of the developments. See figure 2 below. In all areas substantial developments are likely to occur before 2010, prototypes depending mostly of technological feasibility and wider diffusion of user acceptance. Health and entertainment, especially gaming, are identified as two of the driving areas.

Enabling and Constraining Factors

User-friendliness, including advanced and multi-modal interfaces and interoperability, is essential for the wide acceptance of AmI applications. Similarly, concerns over trust, security and privacy issues have to be addressed so as not to hinder the diffusion of AmI.

Opportunities

It is shown that due to their emphasis on human-centred innovation, AmI functions have the potential to contribute to wider access to ICT functions and thereby to social inclusion, participation and cohesion. New forms of socialisation will continue to emerge.

Applications	Key Function	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	> 2020
Cultural Heritage	Preservation of cultural heritage	Large scale digitalisation of written materials			Increased interconnection of databases			Large scale digitalisation of multimedia materials												
	Organisation of cultural heritage				Generalisation of content base classification and indexation															
	Access to and retrieval of cultural heritage	Online libraries				Generalisation of retrieval of cultural heritage on demand														
	Intelligent heritage and cultural tourism (historical sites/museums/ exhibitions)	First generation interactive and augmented reality exhibitions						Multi-sensorial, multi modal exhibitions												
								Tourism in some areas limited to Net access			3D exhibitions using holographic displays									
							Widespread use of virtual reality for education and recreation										Widespread use of virtual environments			
Cultural Participation	“Out-of-house” cultural participation and recreation																			
	Creation & Art							Multi-sensoral, multi modal, augmented reality works of art						Computers have humanlike creativity						
																	Direct brain-brain communication of information and feelings			

Fig. 2: The culture function roadmap

Access to Future Technologies

Some applications of ICT technologies in terms of useful, accessible and trustworthy innovative functions have been highlighted. These functions are effectively the starting point and leading dimension of the approach, before key technologies and time. This is one of the main specificities and added values of the outcome compared to the existing corporate and industry roadmaps. The “function-oriented” approach provides fruitful ways of thinking about useful and accessible services and about the interrelationship between the technological and the human - economic, social, political and demographic - dimensions of Ambient Intelligence. The Roadmapping project makes clear that, given the complexity, diversity and richness of everyday life, a one-shot full implementation of AmI is unrealistic. Rather, gradual and partial diffusion can be expected. A recommendation for policymakers is to improve the access to future technological developments, diversity and flexibility at all steps of the value chain. Certainly technological developments are necessary but far from sufficient for the realisation of the AmI vision. Even, the relevance of the AmI vision, that it is going to increase the well-being, make life easier or more attractive, is not universally accepted among IST researchers and policy-makers. There would be a need for complementary exercises of scenario and trend building to further link economic (cost), political (incentives) and social (skills, user groups) factors to the technological and functional developments already represented within the roadmaps.

Selected Sources and References

- ISTAG, “Scenarios of Ambient Intelligence in 2010”, edited by Ducatel, K., Bogdanowicz, M., Scapolo, F., Leijten, J. & Burgelman, J-C, European Commission, Feb 2001,
- http://esto.jrc.es/docs/roadmapping.html
- O. Da Costa, M. Boden, M. Friedewald, “Science and Technology Roadmapping for Policy Intelligence - Lessons for Future Projects”, Proceedings of the Second Prague Workshop On Futures Studies Methodology, CESES Paper, October 2005, http://ceses.cuni.cz

Summit for the Future 2006

Authors:	Felix Bopp felix@clubofamsterdam.com		
Sponsors:	Club of Amsterdam, University of Amsterdam, HES School of Economics and Business ...		
Type:	International Futures Event		
Organizer:	The Club of Amsterdam		
Duration:	2006	Budget: N/A	Time Horizon: N/A

Background

The 'Summit for the Future' is organized on an annual basis by The Club of Amsterdam. It brings together international Thought Leaders to discuss significant, global challenges and opportunities. In 2006 it focused on the subject of risk and the role of risk in society, innovation and global growth. Without risk taking there is no progress, no growth and no prosperity. The Summit provided an occasion to reflect upon the role of risk in enterprise and society, on how the global spectrum of risk is changing, and on the acquisition of new tools and thinking to harness risk as a force for growth in the future.

The Role Risk in Innovation

The Summit for the Future Report addresses a multitude of aspects and appreciations in a structure generating the ingredients of knowledge and transparency and identifying them as keys to a sustainable future.

The Summit itself has been structured in 5 **Knowledge (disciplinary) Streams**:

- Life Sciences,
- Media & Entertainment,
- Trade and Asian Leadership,
- Healthcare,
- Corporate Governance,

As well as 5 **Interdisciplinary Streams:**

- Innovation as Risk Taking,
- Knowledge based Risk Management,
- Values and Spirituality,
- Cross-Cultural Competence and
- Creative Leadership.

Participants look at the issue of risk through many different lenses and come to the summit with questions. Ample time is allowed for spontaneous inter-session discussion involving over 300 participants from more than 30 countries.

Building a Global Knowledge Network

The Club of Amsterdam can be seen as an engine for shaping the future through networked learning. Bringing people together requires easy access. They must be true to their values to engage with the Club of Amsterdam. The circulation of knowledge moves people forward in their lives and careers. Recommendations from past participants makes the Think Tank grow in membership, in knowledge and in added-value of the process. While examining essential issues related to industry, science, education, government and society the Club of Amsterdam is building a global knowledge network with leading institutes and specialists. The Summit for the Future allows findings from events and publishing throughout the previous year to come into focus.

A Multi-Layered Approach

The Summit was organised around a number of 5 knowledge streams and 5 inter-disciplinary sessions. Each Knowledge Stream session involved the participation of a **Trend Watcher, a Student, a Philosopher and a Psychologis**t, who acted as **Catalysts** for constructive debate. During the second part of the Summit each of these catalysts discussed their joint solutions in a final series of the **Integral Streams.**

KNOWLEDGE STREAMS

INTERDISCIPLINARY STREAMS

INTEGRAL STREAMS

This approach provided us with 36 distinct lens through which to explore the topic Risk:

- 5 Knowledge Streams,
- 5 Interdisciplinary Streams,
- 20 Catalysts,
- 5 Integral Streams and the
- General Overview.

Dealing with the Residue of Risk

It is important to understand that there is a level of risk in any activity. Government and others may do everything they can to mitigate that risk, but it does not entirely go away. There is always an irreducible residue of risk that cannot be removed.

Life is safer than it has ever been but we seem less prepared to accept risk in anything we do. We need to make sensible decisions about what really is dangerous. We should form these by weighing up the facts rather than being susceptible to public hysteria. By making everything appear life threatening we are in danger of crying wolf once too often.

Life Sciences: Networks of SMEs and Corporations

Towards the end of the 20th century we developed recombinant DNA technology. This gives us the ability to produce any protein we desire in any biological system we choose. So we have started to shift the production of proteins and other bio-derived products to more economical biological systems. Now, more than ever, it is important to develop a vision of how we want to collectively advance into the future as a species. One way to increase our chances of success or survival is to change our behaviour, our way of thinking and to raise our awareness.

Large pharmaceutical companies have spread out their biopharmaceutical manufacturing and research arms to carry out R&D and sales functions in order to optimise their capacities, support internal activities and cater to external clients. Outsourcing is a not just a way of cutting costs, it is a strategic option for dealing with risk. It provides an opportunity to establish and foster long-term, strategic relationships with partner companies.

Media & Entertainment: Wireless Markets in Asia as a Driver

In the high-tech and consumer world where product life spans are short and consumer interest is fickle, innovation may be the only effective strategy for long-term prosperity. It is not about the idea. It is about the proposition. Even if you have the best idea in the world, if it is not aligned with the market and consumer wishes, it will fail. This is hard to come to terms with if you come from an organisation that prizes ideas. Open standards act as bridges to inter-connect these islands into archipelagos of functionality which can equal big companies but which also leave room for small players to participate in the eco-system. This is the ideal model for internationalization and it is truly scalable one.

Along with the boom in mobile telephony around the world, a parallel wave of innovation in wireless corporate networking promises to usher in a new world of 'un-tethered knowledge workers' and 'flexible network organisations.' China is viewed as a powerhouse that will benefit Asia as a whole and have repercussions for wireless players around the world. The Asia-Pacific displays a broad diversity in terms of diffusion of wireless markets and industries, over and above the existing matrix of social, political and economic diversity.

Trade and Asian Leadership

India requires a long-term view while for China a quicker reaction pattern is realistic. If we added up the total volume of world trade that can reasonably be described as partnership-enabled, a high percentage of it today would be accounted for by offshore outsourcing, companies transferring back-office functions to territories made attractive by lower labour costs.

Ships from China to the USA are full but empty in the other direction. The cost for a container from China is $800 to $1,400. The cost of a container to China is half of that. China has become the world's third largest merchandise trader after Germany and US. It is also gaining a substantial share in business services outsourcing. Due to the risks and challenges faced by the region, trade in Asia has yet to reach its full potential. Nevertheless the emerging Asian region is expected to grow 6.6% in 2006 according to ADB estimates. The recent acceleration in growth will propagate further restructuring and reforms. These will create rich opportunities accelerated trade growth in the region. In order to boost growth momentum, Asia has to ensure that appropriate measures are taken to manage the risks prevailing in the region through economic cooperation amongst the Asian countries and through continued structural reforms within individual economies.

Healthcare: Introducing the Individual Profile

Healthy survival has a lot to do with 'living up to your genes'. This means that there must be a certain degree of compatibility between life-style patterns 'enabled' by evolution and those practiced by an individual. An assessment of key factors determining individual health can provide individual health-related risk profiles. An integrative physician would approach a patient and their individual situation without prejudice and without a specific preference for a healing method. 61% of those questioned said they would opt for a combination of Chinese and Western medicine. An understanding of the human condition that includes the biological, cognitive, psychological, social and spiritual dimensions forms the basis for all of these interventions. The mind-body model is a very old fashioned model that goes back to Descartes. We now know that this system also contains neural, hormonal and immune systems that work with or without our will. The struggle for a happy life has never been put so sharply in the centre of our emotional, psychological and bodily health and in the centre of power. Like Daedalus we tend to take risks when the possibilities of gains are high but at what cost?

Corporate Governance: Moving towards Stronger Customer Integration

Dialogue is characterized by the postponing of judgment. Too often we offset communicating by starting with verdicts and not with open questions. Our world now is sufficiently in crisis that transparency in all endeavours is critical to survival. Evolution is better understood as the bio-geological process of the Earth as a whole and the changing patterns of species over time, both physiologically and behaviourally, within that larger context. Even the single nucleated cell - the only kind of cell other than bacteria - is now known to be a cooperative enterprise that has evolved from once hostile bacteria. Healthy, mature living systems are dynamically cooperative because every part or member at every level of organization is empowered to negotiate its self-interest within the whole.

Adherence to sound corporate governance is not only the onus of the owners of the company, or those who hold top managerial positions. It is the responsibility of all stakeholders. Customer expectations should not be compromised against adherence and both should be carefully integrated to create a transparent organization delivering customer value at all times.

Cooperation, collaboration and community empowerment are more efficient and effective ways of doing business than living in fear of drowning in a competitive race or wasting energy and resources on beating down the competition.

Seeing Risk as a Chance

Healthcare

The prevailing approach is 'curing the disease'. Through a proactive approach to health we need to move 'from curing to caring'. We need to look beyond the body to look at the being, to go from a fragmented view of healthcare to a more integrated view of the individual that combines the physical with the psychological, mental and emotional health of the patient.

Innovation Experience

We had discussions on entrepreneurship and innovation. These are a part of the human experience everywhere in the world. People have needs, and some of those are the need to plan, to care for families, to build, to construct and to change the world. Our most basic biology demonstrates the fact that we are driven to embrace change, and that we are vectors and factors of change. This is how we anticipate the world's development. The downside of our investment is that we fight these changes as if they were dangerous risks.

The Politics of Fear

There is a 'politics of fear' associated with risk or at least the perception of risk enables a politics of fear. People manipulate people. Communication is a form of manipulation, and one of the things we do is invite force. The way that we propagate politics of fear to influence how people behave is a form of violence. We need to understand what is real in terms of our perception of risk - risks to business, risks to the environment, risks to the planet, risks to ourselves.

Money

Money is not a map of the world, but it is certainly a partial one. And if it is the only one we use we will not navigate the landscape of risk very well. The idea is to move beyond money towards something that is more value-based but includes money. After all money is one of the most powerful tools ever invented. It is one of the most powerful causes for change in the world … but so is communication and so is knowledge!

Media

Media and entertainment drive communication, connectivity, and the diffusion of knowledge. They create new forms of economic activity. Peer to Peer, sharing and Open Source are already movements that have evolved away from a purely money-driven society towards a broader, more value-based economy. This diversification away from money to a broader palette of values is a form of risk mitigation.

The System

Another thread that ran through the meeting was the whole idea of systems. It is so easy to blame 'the system' and so hard to change it. If you feel the need to blame, you can instead look at the system and recognize that part of the way the world is today is in the system, so to speak. But you mustn't forget that it does come down to individuals. Individuals matter and individuals can make a difference. But they must want to make a difference. They need to know that they matter. They need to give themselves the freedom to participate in the world in that way.

There is a movement away from the individual to the system which has led to a range of wonderful emerging ideas about collective being, a collective consciousness, collective intelligence, and the idea that a system made up of individuals is an independent form of life. This emerging collective consciousness is a very positive image, the idea that we are part of a system, but that that decisions do come down to individuals and they can make a difference.

In many parts of the world people have generally become more affluent, educated and free. Leadership and governance systems are changing. Nowadays we all are leaders in some way. Our attitudes to governance and leadership change the way people lead. This is linked to the notation of responsibility and attitude to risk. Rather than seeing risk as something evil, unnecessary, beyond our control and a basis for a politics of fear, we can see it as corresponding to an opportunity, see it as a challenge, as a force for good. Instead of thinking in terms of problems, we have to learn to give ourselves the freedom to act and do something about it, to proactively live with risk and with the consequences.

Sources and References

- The Club of Amsterdam website is at **www.clubofamsterdam.com**
- The report for the Summit for the Future 2006 can be found at **www.clubofamsterdam.com/event.asp?contentid=625&catid=85**

England's Regions 2030

Authors:	Werner Reutter / werner.reutter@rz.hu-berlin.de
Sponsors:	The English Regions Network RDA Planning Leads Group Office of the Deputy Prime Minister The Department for Transport
Type:	National foresight exercise covering all S&T fields and the entire territory of a country
Organizer:	Ove Arup & Partners Ltd., Tom Bridges / tom.bridges@arup.com; Regional Forecasts Ltd., Dr. Graham Gudgin / ggudgin@refor.com; Oxford Economic Forecasting Ltd, Alan Wilson / awilson@oef.com
Duration:	2005 — Budget: n.a. — Time Horizon: 2002-2030

Purpose

In spite of the fact that regions and regional disparities have become important political issues inter-regional aspects are rarely addressed neither scientifically nor politically. The report provides an attempt to forecast economic and demographic changes within regions in England and how these changes will affect inter-regional relations. Thus, the report can also be regarded as a basis for regional planning over the next 25 years. The main goals of the report are, hence, to identify underlying forces in regional economies, describe how the relationships between regions have been changing and will change in the future, and develop a "national perspective" on England's regions. It also explores the opportunities for policy intervention.

England's Regional Policy: In Need of Inter-Regional Strategies

Since the early nineties England's regions - i.e. London, the South, the Midlands and the North - have changed economically, institutionally, politically, and in a European perspective:

- Economically: England has seen continuous growth rates for more than a decade as well as declining unemployment. However, these changes affected the various regions in England unequally.
- Institutionally: since the early nineties systems of regional governance have been established and a number of institutions have been set up in the regions - e.g. Government Offices for the Regions, Regional Development Agencies, Regional Chambers.
- Politically: policy instruments have been developed and put in place. Most important were Public Service Agreements (PSA2) and the Sustained Communities Plan. With the PSA2 the government attempted to raise the rate of growth and narrow the differences between the regions as far as productivity and value added are concerned. The Sustained Communities Plan is a long-term programme of action for delivering sustainable communities both in urban and rural areas.
- Finally, in 1999 the European Union set up a European Spatial Development Perspective (ESDP). The ESDP is a policy framework in order to improve the cooperation between regions. The ESDP seeks cohesion, competitiveness, and sustainable development.

These changes made the British government develop a more pronounced regional policy. There remains a lack on inter-regional strategic thinking even though intra-regional policies are being applied for some time. How regions interact with each other is however a crucial aspect in order to reach the goals laid out in the Sustained Communities Plan and PSA2.

The report "England's Regions in 2030" not only provides background information on England's regions but it also presents projections on regional developments until 2030. Based on the forecasts the report identifies political issues and possible interventions by the government. Finally it lays out different scenarios.

Sound Analysis of Past Developments and Guidelines for Policy Interventions

As far as the projections are concerned the report shows a classical approach: The report first identifies economic and demographic trends that have been proven as robust and shaped past developments in the different regions. The report makes forecasts based on these findings and including national and international changes, which in turn are the point of reference for highlighting political issues that might positively or negatively affect the regions' capacities to reach the goals laid out in the PSA2 and the Sustained Community Plan. Finally, three scenarios describe possible futures of the regions in England.

A project steering group comprising representatives from local, regional and national branches of executives as well as members of Regional Assemblies oversaw the study. The steering group commented on various drafts of the report and its members participated in a brainstorming workshop to discuss the findings and notably policy issues and scenarios that are based on long-term trends and possible policy interventions.

For the forecast a Multi-Regional Model (MRM) was applied. The MRM is a complex model with well-articulated feedback links between labour supply, population growth, employment demands, and personal incomes. At the same time MRM takes the results of macro-economic and industry models (OEF) into account in order to have its regional projections made fully consistent with the macro-economic parameters. MRM has first been applied in 1985; and Regional Forecasts Ltd. publishes reports based on this model on a biannual basis.

Figure 1 shows the stages of the study approach. Overall this is a highly sophisticated and well-developed approach that not only provides a sound analysis of past developments but also clear projections and guidelines for policy intervention.

The Post-Industrial World and Regional Developments in England

In the last thirty years England's economy has changed fundamentally. It had to adjust to a postindustrial world and it will continue on this path. Overall this meant a decline of employment in manufacturing and an increase of employment in the service industries.

Public Sector to Ease Uneven Economy

It goes without saying that the regions profited differently from these changes. Measured by productivity (Gross Value Added (GVA)/employed person), London and the South did far better than the Midlands and the North. This is mainly due to the higher proportion of private sector services in the South and London; and as a rule private services are higher paid and generally employ higher skilled workforce while the public service is still more important in the North and the Midlands and has generally a lower productivity.

Nonetheless, there are some significant exceptions within regions. Notably big cities and hotspots experienced faster economic growth than their respective rural surroundings. This is especially true for London in the South and to a lower degree for West Yorkshire and Manchester. The government has reacted to these uneven developments and has invested in the public service in the Midlands and the North.

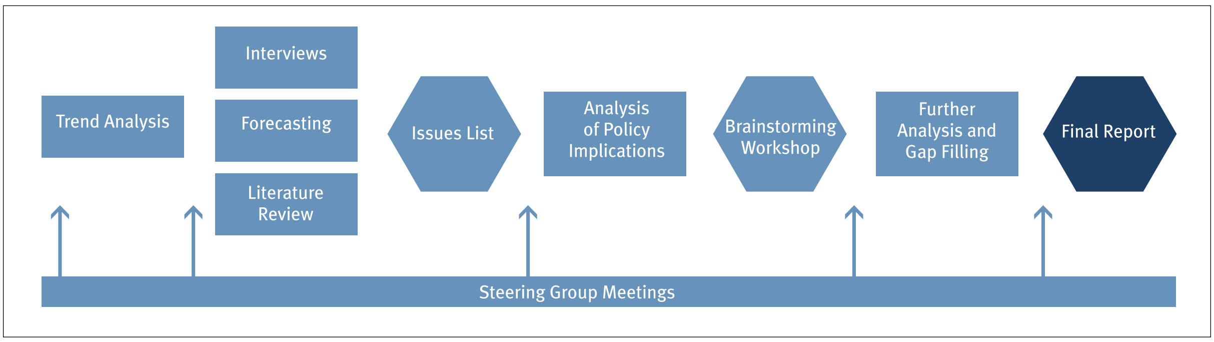
Disparities Continue to Grow

Similar regional patterns have emerged as far as high technology companies, research and innovation are concerned. Once again, there is a gap between the North and the South and between rural and urban areas. This goes together with the fact that vibrant cities offer better job opportunities for graduates.

In the future the past economic trends will very likely continue throughout the period to 2030. Two developments are especially noteworthy:

- First and maybe most importantly, overall England will have high growth rates. In other words, in 25 years time a citizen will be twice as rich as now. Furthermore, the existing disparities between and within regions will very likely widen rather than narrow. Hence, London and the South will further enjoy their already existing advantages, while – relatively speaking – the North and the Midlands will fall back, but they will still see economic growth.
- Second, England's economy is on a clear path toward a service industry. Employment in manufacturing industry will continue to decline, while the number of jobs in the service industry will increase. Also in this respect

Figure 1: Study Approach: Stages



the differences between regions and within regions –i.e. between prospering cities and laggard rural areas –will persist.

Demography: London Shows Highest Growth Rate

In 1996 the Office for National Statistics (ONS) predicted an overall population increase of 6.9 percent until 2021. In its 2003-based populations projections the ONS predicted an increase of 11.1 percent until the year 2028. According to the latter forecast the North East will be the only region with a declining population, in all other regions the population will increase. Other demographic changes concern international and national migration flows and a raising share of people older than fifty.

Again, London shows the highest growth rate in population due to a continuous influx of young immigrants, while older people will probably out-flow of the city. Apart from London, the natural increase in population is highest in the South East and East of England.

These changes in population will foster the long-term trend of household growth. Respective forecasts predict nearly 189.000 additional households until the year 2021. Some three quarters of this growth will take place in the Southern regions and East Midland. Other regions can expect some growth in households too, but to a lower degree.

The demographic changes will have important ramifications on housing as well. Nonetheless, a rapid increase in housing supply is highly unlikely. This will worsen the already inflationary pressure on the housing market in London and the South East area.

Can Policies Mitigate Inter-regional Disparities?

Needless to say that these changes will raise a number of issues that policy makers and planners will have to address and deal with. The report mentions:

- Spatial development issues - e.g. location of growth industries, the role of London and other city regions, environmental issues,
- Off-shoring,
- Economic development issues - new clusters, regional industrial policy, consumption factors,
- Working practices and transport.

Government policy as stated in the PSA2 target is to raise economic growth in all regions and reduce the gaps between regions. These are challenging objectives because the past trends are structural and have proven highly resilient to change which, of course, limits the chances and effectiveness of public interventions. In addition, one has to keep in mind that even though certain policy interventions may have positive effects on the national, sub-regional, or local level, inter-regional dimensions may require different policies.

The report lists a number of possible policy interventions - spatial planning, economic development, transport, public spending, and public sector location and activity. Lumped together four areas seem of special relevance:

First, policy-makers have to tackle the question as to how far the government should support growth particularly in London and the South East. Current policies restrict the growth potential to the South of England. Yet, the potential for spatial planning to limit the gap between the South and London on the one side and the North and the Midlands on the other is restricted. Furthermore, the resources are limited and will hardly be sufficient to make a significant contribution in order to overcome or mitigate regional disparities. Overall this means that public intervention will have only limited effects on inter-regional developments.

Second, structural change will continue to produce unemployment and job losses. In addition, there are areas of deprivation in the South, in inner London and coastal towns. Government has to deal with this kind of problems.

Third, a higher mobility will lead to an increasing travel demand. Good transport networks will be essential for national and regional competitiveness. Hence, it will be crucial that cities and regions are well connected in order to avoid delays and congestion. The state will have to address capacity constraints by managing travel demand and by providing new investments. At the same time climate change, flooding and water supply require political action. In consequence, environmental policy will become far more important.

Fourth, the potential to decentralise functions to the regions will continue to grow. This sort of devolution would strictly concern administrative tasks. Currently, it does not look as if England's regions want to have parliaments of their own - like in Scotland and Wales. Nonetheless, decentralising administrative functions would reduce costs and provide employment opportunities in those regions with comparatively weak economies.

Three Scenarios

Based on the trend-based prognosis and possible policy interventions the report identifies three scenarios for regional development and change.

Scenario 1 – Constraining growth in the South:
This scenario assumes to further restrict housing supply,

transport capacity and employment in the South in order to achieve two goals: to relieve the pressure on London and the South on the one hand and to help push economic development to the North and the Midlands on the other. However, the report finds this strategy as extremely risky. It is unlikely that such a strategy would improve the situation in the North and the Midlands while it could easily jeopardize the overall growth target.

Scenario 2 – Planning for growth in the South:
The government could expand transport capacity in the South and provide means in order to ease the pressure on the housing market. According to the report such a scenario is quite promising because it could raise the level of national economic performance, which heavily relies on London and the South. However, it could only work if sufficient public investment is made. In addition, it would neither stimulate the competitiveness nor initiate structural change in the North.

Scenario 3 – City-region renaissance in the North, Midland and peripheral parts of the South:
The approach currently under consideration in the Office of Deputy Minister focuses on city-regions. According to the report this approach is the least vulnerable to oil price fluctuations and the best for climate change. In addition, Scenario 3 is not in conflict with Scenario 2.

The Downside of Policy Intervention

Overall, this report does not only meet the highest methodological standards but it also provides ample information on past trends and gives a clear picture on future developments. In addition, it highlights consequences of possible public interventions. Even though the report does not recommend specific policies it describes the context within which decisions will be made. According to the report the government has two options: In order to reduce disparities between regions the government can intervene into the national and regional economies and redistribute wealth from the prosperous south to weaker regions in the North and Midlands. However, based on the report such a policy would have rather negative long-term effects because it would lead to higher costs, increase inflations, hamper competitiveness etc. In sum it could restrain national growth rates. Nonetheless, national government and regional bodies will have to strike a balance between economic necessities, environmental problems, regional disparities and those in needs. In spite of the solid and seasoned approach and the sophisticated method the report acknowledges that it can “just” present a trend-based prognosis. In essence the forecast is a prolongation of past structures into the future. The report does not claim to predict the unpredictable: the “next big thing” that might alter economic and social structures.

Sources and References

http://www.emra.gov.uk/

Global Technology Revolution 2020

Authors:	Richard Silberglitt / richard@rand.org Philip S. Antón / anton@rand.org David R. Howell / howell@rand.org Anny Wong / annyw@rand.org		
Sponsors:	The U.S. National Intelligence Council		
Type:	International foresight, covering issues from a global perspective		
Organizer:	RAND - Richard Silberglitt and p S. Antón		
Duration:	2004 - 2005	Budget: n.a.	Time Horizon: 2020

Purpose

The intention of this forward looking study was to inform the U.S. National Intelligence Council's 2020 project - www.dni.gov/nic/NIC_2020_project.html - and help provide U.S. policymakers with a view of how world developments could evolve, identifying opportunities and potentially negative developments that might warrant policy action.

Global Technology Developments

This technical foresight was intended to provide science and technology input to the U.S. National Intelligence Council's 2020 project, which considered a wide range of possible world developments, and their policy ramifications. It was an update and extension of the previous RAND report, The Global Technology Revolution, published in 2001, which provided the science and technology background for the National Intelligence Council's 2015 study.

Multiple-disciplinary Technologies Revolutionizing our Lives

In its previous foresight study, The Global Technology Revolution, RAND concluded that life in 2015 would be revolutionized by the growing effect of multidisciplinary technology across all dimensions of life: social, economic, political, and personal. This study had the objectives of extending the technology trend foresights to 2020, and probing deeper into the applications of emerging technologies, as well as their societal implications across the globe.

The following were some specific goals:

- Carry out detailed technology trend foresights in biotechnology, nanotechnology, information technology, and materials technology,
- Identify, based on these foresights, technology applications that were plausible by 2020 with potential for significant societal impact,
- Rank these technology applications based on technical feasibility, implementation feasibility, societal impact, and potential for global diffusion,
- Analyze international variations in the potential effects of these technology applications.

From Literature Review to Expert Judgement

This foresight study was based on a set of broad and deep reviews of the current research and development (R&D) literature and state-of-the-art carried out by technical area experts. These experts then identified plausible future technologies within a fifteen year time period that were based on an understanding of required technical developments, coupled with their judgments as to the feasibility of such developments.

Based on these technical foresights, the authors of the study identified **technology applications** - i.e., uses of future technologies that provide a desired function such as cheap solar energy or rural wireless communications. The authors then performed a rough net assessment of these technology applications according to:

- The number of **societal sectors** - water, food, land, population, governance, social structure, energy, health, economic development, education, defense/conflict, environment/pollution - that the technology application could impact,
- **Technical feasibility,** defined by the likelihood that a commercial product would be available based on this technology application by 2020,
- **Implementation feasibility,** defined by the rough

size of the market that might exist for this technology application by 2020, and whether or not it raises public policy issues - e.g., ethical, privacy,
- Whether the technology application has the potential for **global diffusion**, or whether diffusion would be moderated because of appeal to limited economic, commercial, or social sectors, or countries or regions.

Technology Scan in 29 Countries

Finally, the authors defined **29 representative countries** around the world, and evaluated their human, physical, and institutional **capacity to acquire** a representative group of the top-ranked technology applications. The representative countries were selected for variation in size, region of the world, and socio-political conditions. The foresight experts then considered the **drivers** for and **barriers** to sustained widespread implementation of the top-ranked technology application within each representative country. Drivers and barriers considered were: cost and financing; laws and policies; social values, public opinion, and politics; infrastructure; privacy concerns; resource use and environmental health; research and development investment; education and literacy; population and demographics; governance and political stability. Combining the capacity to acquire technology applications with the drivers and barriers allowed us to evaluate the capacity of each representative country to implement the top-ranked technology applications, and on this basis the foresight experts were able to draw conclusions concerning cross-country variations.

Regional Disparities

Where people live will have a big impact on how new technology applications affect their personal health and standard of living and the environment. The 29 representative countries fall into four levels of science and technology capacity:

- **Scientifically Advanced** countries - Australia, Canada and Germany representing Western Europe and Israel, Japan, South Korea and the U.S. - will benefit from most technology advances, regardless of sophistication. These countries will be poised to implement, as they choose - e.g., targeted drug therapies, improved and less invasive diagnostics and surgery, engineered tissues, ubiquitous information access, advanced security methods, environmentally-friendly manufacturing, ubiquitous tracking devices, and pervasive sensor networks.
- **Scientifically Proficient** countries - China, India and Poland representing Eastern Europe, and Russia - will benefit from many, but not all, of the most sophisticated technology advances. These countries will likely see vastly improved medical diagnostics, drug therapies, and surgical procedures, advanced security techniques, as well as all of the improvements described below for the scientifically developing countries.
- **Scientifically Developing** countries - Brazil, Chile, Colombia, Indonesia, Mexico, Turkey, and South Africa - will be poised to take advantage of modestly sophisticated technology advances. These countries will have access to more efficient and environmentally friendly transportation technologies and manufacturing, as well as improved medical diagnostics and all of the improvements described below for the scientifically lagging countries.
- **Scientifically Lagging** countries - Cameroon, Chad, Dominican Republic, Egypt, Fiji, Georgia, Iran, Jordan, Kenya, Nepal, and Pakistan - will need to make concerted efforts to eliminate barriers to and support simple technology advances. The principal drivers for advanced technology implementation in these countries will be human development needs, effective management of resources, and prevention of pollution and environmental damage. The most challenging barriers will include honest and effective governance, political stability, and matching of the available technology applications to the social and cultural conditions and local needs such as remote power and communications, clean water, and food and shelter.

The 16 Top Ranking Applications Identified

The following were the top-ranked 2020 technology applications:

- **Cheap solar energy:** Solar energy systems inexpensive enough to be widely available to developing and undeveloped countries as well as to economically disadvantaged populations that are not on existing power grids.
- **Rural wireless communications:** Widely available telephone and Internet connectivity without a wired network infrastructure.
- **Communication devices for ubiquitous information access:** Communication and storage devices - both wired and wireless - that provide agile access to information sources anywhere, anytime. Operating seamlessly across communication and data storage protocols, these devices will have growing capabilities to store not only text but also meta-text with layered contextual information, images, voice, music, video, and movies.
- **Genetically modified (GM) crops:** Genetically engineered foods with improved nutritional value - e.g., through added vitamins and micronutrients, increased production - e.g., by tailoring crops to local conditions, and reduced pesticide use - e.g., by increasing resistance to pests.
- **Rapid bioassays:** Simple, multiple tests that can be performed quickly and simultaneously to verify the presence or absence of specific biological substances.
- **Filters and catalysts:** Techniques and devices to effectively and reliably filter, purify, and decontaminate water locally using unskilled labor.

- **Targeted drug delivery:** Drug therapies that preferentially attack specific tumors or pathogens without harming healthy tissues and cells.
- **Cheap autonomous housing:** Self-sufficient and affordable housing that provides shelter adaptable to local conditions as well as energy for heating, cooling, and cooking.
- **Green manufacturing:** Redesigned manufacturing processes that either eliminate or greatly reduce waste streams and the need to use toxic materials.
- **Ubiquitous radio frequency identification (RFID) tagging of commercial products and individuals**: Widespread use of RFID tags to track retail products from manufacture through sale and beyond, as well as track individuals and their movements.
- **Hybrid vehicles:** Automobiles available to the mass market with power systems that combine internal combustion and other power sources.
- **Pervasive sensors:** Presence of sensors in most public areas and networks of sensor data to accomplish widespread real-time surveillance.
- **Tissue engineering:** The design and engineering of living tissue for implantation and replacement.
- **Improved diagnostic and surgical methods:** Technologies that improve the precision of diagnoses and greatly increase the accuracy and efficacy of surgical procedures while reducing invasiveness and recovery time.
- **Wearable computers:** Computational devices embedded in clothing or other wearable items such as handbags, purses, or jewelry.
- **Quantum cryptography:** Quantum mechanical methods that encode information for secure transfer.

Lagging Countries Need Stable Institutions and Social Equity First

For scientifically lagging and developing countries, implementing technology applications to address problems and issues will not be primarily about technology, or even science and technology (S&T) capacity. The greater challenge they will face is the lack of institutional, human, and physical capacity, including effective governance. Development results from improvements in economic growth, social equity, health and the environment, public safety and security, and good governance and stability. Those countries with the best performance in these indicators of development will most likely have the greatest institutional, human, and physical capacity to implement technology applications. Less-developed countries that hope to benefit from technology applications will have to improve their performance in these development areas to build the requisite institutional, human, and physical capacity.

However, several of the technology applications listed in the previous section require little S&T capacity - e.g., cheap solar energy can provide power for water pumping and irrigation, as well as lighting and village electricity. Together with rural wireless communication, it can enable rural education, as well as cottage industries for rural economic development. The addition of filters and catalysts to provide clean water and improved rural hygiene could enable vast improvements in health and human development. Genetically modified crops have the potential to address severe local and regional problems stemming from malnutrition.

Trajectories of the Global Technology Revolution

As the global technology revolution proceeds over the next 15 years, it will follow a trajectory with certain defining characteristics.

Accelerated Technology Development Will Continue: The authors of the forward looking study see no indication that the rapid pace of technology development will slow in the next decade and a half. Nor will the trends toward multi-disciplinarity and the increasingly integrated nature of technology applications reverse. Indeed, most of the top 16 technology applications for 2020 draw from at least three of the areas addressed in this study - biotechnology, nanotechnology, materials technology, and information technology - and many involve all four. Underlying these trends are global communications - Internet connectivity, scientific conferences, and publications - and instrumentation advances - the development and cross-fertilization of ever more sensitive and selective instrumentation.

Different Countries Will Benefit in Considerably Different Ways: Over the next 15 years, certain countries will possess vastly different S&T capacities. They will vary considerably as well in the institutional, human, and physical capacity required to develop drivers for implementing technology applications and overcome barriers. Furthermore, different countries have different needs and uses for technology applications. Consequently, the global technology revolution will play out quite differently among nations.

Scientifically Advanced Countries will Gain the Most: The scientifically advanced countries of North America, Western Europe, Asia, and Australia are likely to gain the most as exemplified by their capacity to acquire and implement all of the top 16 example technology applications. For whatever problems and issues that rank high on their national agendas, they will be able to put into practice a wide range of applications to help address them.

Emerging Economies to Use Technologies for Continued Growth: If they can address multiple barriers to implementation, emerging economies such as China and India in Asia and Brazil and Chile in South America will be able to use technology applications to support continued economic growth and human development for their populations. China and India as emerging technological powers will have the best opportunity to approach the ability of the scientifically advanced countries to use applications to achieve national goals.

The scientifically proficient countries of Eastern Europe, as represented by Poland, appear to be poised next in line behind China and India. In contrast, it looks likely that Russia's capacity to implement technology applications will continue to deteriorate, with the most advanced of the scientifically developing countries - represented by Brazil, Chile, Mexico, and Turkey - potentially overtaking her.

Lagging Countries Endangered of Falling Further Behind: The scientifically lagging countries around the world will face the most severe problems - disease, lack of clean water and sanitation, and environmental degradation. They will also likely lack the resources to address these problems. Consequently, they stand to gain the most from implementing the 2020 technology applications. However, to do so, these nations will need to make substantial inroads in building institutional, physical and human capacity. The efforts and sponsorship of international aid agencies and countries may assist in these efforts, but the countries themselves will have to improve governance and achieve greater stability before they will be able to benefit from available S&T innovations.

Actions Required for Maintaining a High Level of S&T Capacity: The accelerating pace of technology development and the growing capacity of emerging economies to acquire and implement technology applications will make economic security a moving target even for the most advanced nations. If countries are to stay ahead in their capacity to implement applications, they will need to make continuing efforts to assure that laws, public opinion, investment in R&D, and education and literacy are drivers for- and not barriers to- technology implementation. In addition, they will have to build and maintain whatever infrastructure is needed to implement those applications that will give them a competitive advantage.

Some Technology Applications Will Spark Heated Public Debate: Several of the top-ranked technology applications will raise significant public policy issues that will trigger strong, and sometimes conflicting, reactions and opinions between countries, regions, and ethnic, religious, cultural, and other interest groups. Many of the most controversial applications will involve biotechnology - GM crops, for example. Others, such as pervasive sensors and certain uses of RFID implants to track and identify people, will potentially have provocative implications for personal privacy and freedom. Yet any controversy that flares up will probably not be the same around the world. A technology application that could raise extremely divisive questions in one country may cause no stir at all in another due to different social values.

Consideration Can Head-off Problems and Maximize Benefits: Public policy issues will need to be resolved before a country will be able to realize the full benefits of a technology application. Not all technology may be good or appropriate in every circumstance and just because a country can do a thing does not necessarily mean that it should. Ethical, safety, and public concerns will require careful analysis and consideration. Public policy issues will need to be debated in an environment that seeks to resolve conflicts. Such public debates, in addition to being based on sound data, will need to be inclusive and sensitive to the range of traditions, values, and cultures within a society. In some cases, issues will remain after the debate, slowing or even stopping technology implementation. Sometimes the reasons will be clearly good - e.g., when safety concerns cannot be adequately addressed - and sometimes the result will simply reflect collective decision-making determining what a particular society wants and does not want.

Sources and References

The Global Technology Revolution 2020, Executive Summary: Bio/Nano/Materials/Information Trends, Drivers, Barriers and Social Implications, MG-475-NIC, RAND Corporation, (2006). The Global Technology Revolution 2020, In-Depth Analyses: Bio/Nano/Materials/Information Trends, Drivers, Barriers and Social Implications, TR-303-NIC, RAND Corporation, (2006) and The Global Technology Revolution: Bio/Nano/ Materials Trends and Their Synergies with Information Technology by 2015, MR-1307-NIC, RAND Corporation 2001. All are available from **www.rand.org/pubs.**

Government and Corporate Social Responsibility 2020

Authors:	Julie Koeltz of Louis Lengrand & Associés / julie@ll-a.fr, Cécile Jolly - Project Director at the Commissariat Général du Plan / cecile.jolly@strategie.gouv.fr		
Sponsors:	Commissariat Général du Plan of the French Government		
Type:	Single issue national foresight exercise		
Organizer:	Commissariat Général du Plan of the French government		
Duration:	2004 to 2005	Budget: n.a.	Time Horizon: 2020

Purpose

While corporate social responsibility is increasingly requested in order to respond to current environmental challenges and threats to public health, the ISIS group of the Commissariat Général du Plan of the French Government ("The Plan") analyses trends in corporate behaviour as well as regulatory principles underlying sustainable development and corporate social responsibility. Beyond this, the ISIS group explores future issues in different sectors in order to illustrate existing junctions and differences. Based on this prospective analysis, ISIS built four strategic scenarios for state intervention to make an inventory of tools to urge enterprises encompassing social and environmental issues in their schemes for economic developmen

A New Challenge for the State

The ISIS project was launched in September 2004 in order to provide public authorities with an outlook on sustainable development and corporate social responsibility with a focus on the future role of the French government. Indeed, Corporate Social Responsibility (CSR) in France is, on the public side, an emerging matter since the French government does not have a long history of collaboration with private individual initiatives with regard to sustainable development issues.

The project explored different public strategies for integrating initiatives. This was based on an observation of CSR trends in four sectors - **chemistry, textile & clothing, logistics and eco-technologies** - and on the analysis of technological forecasts. The initiatives were expressed by the civil society and support incorporating social and environmental concerns into their development.

Need for a Wide Range of Participants

Considering the large scope of the ISI project and the variety of perceptions of CSR's relevance, the core team decided to implement a permanent group of stakeholders, gathering representatives of companies, unions, NGOs, public administrations and academic experts. Besides this continuous dialogue, the team relied on existing quantitative forecasts, especially for sectoral and environmental observations. Through the mix of deskwork and fieldwork, the team managed to elaborate technological roadmaps for the four sectors studied within this exercise. The project followed three phases.

During **the first phase**, several public hearings, involving nearly one hundred participants, took place, covering three wide topics:

- Competitiveness, environment and R&D,
- Social issues, governance and international regulation,
- Classification and labelling of negative substance and sustainable development.

These hearings aimed at drawing state-of-the-art current trends of CSR, including the sectoral level. During **the second phase,** the project targeted specific subjects and invited experts who had taken part in previous meetings to build scenarios. These experts were grouped within four sectoral workshops:

- Chemistry,
- Logistics and transport,
- Eco-industries and eco-technologies,
- Textile and clothing.

The following transversal issues were discussed in workshops as well:

- Social stakeholders positioning,
- Financial markets role,
- Labelling of negative substance and legislating in a view to regulate products having a negative impact on sustainable development,
- International and EU governance.

Several scenarios, built for those eight topics, made the drawing of potential "postures" for the French State possible. In **the last phase**, the team, with the support of external participants, elaborated different scenarios applied to the French State's behaviour and provided recommendations on the most advisable public policies. Several experts, including two economists specialised in environmental issues, one expert in R&D programmes and one in social issues comprised the project team. The team was assisted by an external group of professors and consultants remunerated for one day per week spent on specific tasks such as the organisation and moderation of meetings as well as the writing of reports.

Sustainable Development: An Issue for Business and Society

New models of governance have recently emerged in order to meet the current challenges of sustainable development, in a context characterised by the civil society's health, environmental and societal concerns. Corporate Social Responsibility has emerged from the growing civil and political pressure on companies to operate in an economically, socially and environmentally sustainable way. To this respect, private firms have launched three types of voluntary actions to contribute to sustainable development goals, which are: environmental standards, social protection and ethical concerns related to prevention of child labour or safety at work for example.

Corporations Need to Take Environmental and Social Responsibility Worldwide

Alongside climate change, a growing concern is to limit people's exposure to dangerous substances. To this respect, the REACH regulation (Registration, Evaluation and Authorisation of CHemicals) represents a major innovation. According to a study led by the European Commission, the full implementation of the REACH regulation would save about 4,500 lives per year plus the cost of healthcare, judicial procedures and compensations. Developed countries are endowed with solid legislations; developing countries and less advanced countries are not. As most large companies are settled all around the world, the impact of national or regional laws is more and more diluted because companies can, for example, delocalise polluting activities were legislation is less constraining. For this reason, large companies are asked to adopt internal rules to be enforced by all subsidiaries and stockholders.

The Reorganisation of Social Partnership

This issue is particularly relevant regarding social aspects. Delocalisation, sub-contracting and outsourcing have broken down businesses' boundaries as well as former national social regulation models that were based on the Fordian labour compromise. Trade unions, who used to be key participants in the social dialogue, are facing major difficulties, because they still intervene in domestic frameworks with the support of national legislations. As a result, trade unions are somehow powerless with regard to the increasing demand from the civil society for production processes compliant with ethical and social standards.

Sectoral Implications

The **chemistry sector** is facing criticism because it causes pollution and causes risks to human health, leading to regulations that are very restrictive. According to OECD statistics, production in the chemistry sector is likely to increase by 85% in the following 20 years. As a result, CO_2 emission could increase by 66% in the OECD member States and by 165% in others.

Regarding the future of chemistry and environmental concerns, three scenarios have been elaborated for the ISIS project:

- In the first scenario, the chemistry sector focuses on research to cope with restrictive regulations so that **pollution diminishes in industrialised countries**. On the other hand, pollution in developing countries becomes non-sustainable and technology transfers are limited because of the willingness to keep the sector's competitiveness in France and Europe.
- The second scenario forecasts a drastic **decline of the European chemistry sector because of a constraining regulation**, a lack of research and a difficult access to natural resources. In addition, following a major environmental disaster, the population could reject establishment of those industries ("NIMBY regime") or any further technological innovation like e.g. nano-technologies. One of the main consequences would be the development of this industry in Asia and an important increase in maritime traffic.
- The last scenario views a **strong collaboration between governments, NGOs and companies.** Environmental concerns are taken in great consideration and dealt with efficiently. However, the elaboration of agreements and the increase of administrative procedures slow down industrial exploitation and commercialisation of research outputs.

The **textiles and clothing** chain of distribution is characterised by a very strong international distribution of work. This distribution chain embodies the crucial question of sub-contracting and working conditions. Three scenarios can be considered according to a range of variables such as trade conditions, innovation and transport costs.

- In the first case, **environmental and social responsibility is promoted as a mean to protect domestic T&C industry.** Trade Unions focus on employment protection whereas NGOs try desperately to implement social and environmental agreements in developing countries.
- The second scenario predicts the **emergence of a certain corporate social responsibility compatible with free trade.** The T&C production is mostly concentrated in Asia - China and India. The extinction of the traditional T&C industry in Europe made the collaboration between Trade Unions, NGOs and governments possible so that global initiatives are launched. Social and environmental standards' compliance is however difficult to validate because of mass sub-contracting.
- Another option consists of a focus on the development of preferential zones that may allow the textile sector to grow stronger and even to **"export" a European social model**, first in the periphery of Europe, than to other countries that may adopt a higher standard to break into the preferential zones' markets.

The **logistic/transport sector** has emerged from the companies' inclination to outsource storage and movement of goods and to re-focus on their core operations. Although the emergence of logistics was favoured by the international distribution of work and low costs of transport, the growth of this activity will necessarily be limited by the continuous rise in the price of oil and by transports' impact on the climate change and urban pollution. As a result, the future of logistics will depend on several factors: such as environmental pressure - regulatory or consumer-actors, technological advances, the price rise in hydrocarbons but also the developments within national and European specialisation, as well as the location of storage platforms in relation to outlet markets.

Opportunities and Challenges: Eco-technologies and Corporate Social Responsibility

Development of eco-technologies is closely linked to the progression of environmental regulation, essentially originating from the European community. Currently dominated by incremental innovations for the past twenty years, the sector is today in a phase of international development that requires technological breakthroughs. Future innovations should concern recycling and product life cycle management (2007-2013), clean vehicles (2010), intelligent water treatment (2020) and new renewable energy (2020-2030).

As a matter of fact, **public and private financial bodies** as well as organisation and direction of environmental research in France and Europe will have a decisive impact on the sector's potential. This type of research will only be well funded if financial markets integrate environment concerns in their profitability estimations. These actors still have a rather shortsighted perception.

Ethical funds are perceived as a way to support the development of eco-friendly economic activities and socially responsible companies. These funds are still considered as "niches" but could be generalised when considering the growing public pressure through the importance of household savings and private pension schemes in financial markets as well as the adoption of environmental and social criteria in public investments and procurements.

A last, challenge for the development of corporate social responsibility is the **participation of the civil society through NGOs and trade unions** (Clean Clothes Campaign for example). Groupings built upon the model of unions' confederations could represent an efficient way to deal with transversal issues and directly negotiate with governments and international organisations.

Horizon 2020

Four Strategic Positions for the State

Considering that different alternatives in private and public collaboration - or non-collaboration - could occur in France, the ISIS project team puts forward four scenarios for the French government: the adaptor, the integrator, the regulator and the follower.

In the **"regulator"** scenario, the government turns back to interventionist modes without necessarily having the power to do so. These modes are more prescriptive and in line with a centralising tradition that disregards private players and has little impact on market regulations and international authorities.

The **"follower"** scenario is based on a "business as usual" approach dominated by market regulations in which the state is bypassed by private regulatory systems and those issued by other levels of intervention. As standards are only elaborated by big companies, necessary adjustments are however not effective. This can lead to ecological disaster or increased social tensions. Other players like regional states, especially local authorities, could take on the challenges of sustainable development.

Unlike the two previous strategies, the **"adaptor"** and "integrator" scenarios are seen as the most desirable. They imply that public authorities would have adjusted their intervention modes in order to promote sustainable development and integrated the notion of CSR. In the strategy of adaptation, the state catches opportunities initiated at other levels of regulation or by companies themselves. This strategy is relatively well adapted to the challenges of non-localised pollution like greenhouse gases, for which the solution must be worldwide and consensual. It is however less efficient with regards to social concerns, dealt at national levels.

In contrast, the position of the **"integrator"** state is also highly consensual in its interventions but pre-arranges and somehow predicts future regulations. Thus, standards are co-elaborated and the State promotes co-regulation of the CRSE governance. Adopting such a strategy would be more suitable for the challenges of localised pollution, social issues and less globalised sectors.

Six Recommendations to Public Authorities

- **To call up social and civil dialogue:** The 'integrator' state orchestrates in advance a civil and social dialogue on corporate social responsibility. To this respect, it has to develop CSR agreements in public-owned - or partly owned - companies and to set out the challenges of CSR.
- **Promote socially responsible consumption, energy saving and green production processes:** While public purchases account for 15 % of the GDP, promoting social and environmental responsibility operates in particular by fixing quotas and priorities in order to develop eco-responsible public purchases and investments. The state also uses its economic instruments to encourage the consumption of sustainable products and to bring forward the application of the polluter/payer principle.
- **Establish rules for financial markets and products standards that will facilitate sustainable development:** Financial markets' regulation particularly requires strengthening of disclosure obligations for institutional investors.
- These obligations would specify how to take into consideration social and environmental criteria and how to make a compulsory social rating for all stock market flotation on the date due.
- **Co-ordinate a breakthrough in environmental R&D:** Directing research involves imposing on public/private technological platforms. Financing breakthrough innovations with high cost and uncertain gains needs state investment through public demands, mechanisms aiming at encouraging public loans and pool funding at European level or between member states.
- **Control and monitor the franchising of «sustainable development» claims:** The state strengthens its powers in the area of monitoring the market to avoid false declarations and litigation. To this respect, it draws up a precise list of terms and conditions for applying social or environmental labels or imposes a form of product labelling.
- **Promote existing standards within the European community with a no protectionist agenda**: In international and European community negotiations, the French state brings all its power and influence to bear with the aim of extending and deepening the Kyoto protocol in order to strengthen the French and European social and environmental model. To do so, the state first supports the establishment of a standardisation process in the Pan-Europe-Mediterranean with regionalised certification centres (Turkey, PECO).

Results

Based on ISIS' recommendations, a dialogue has been established between the chemistry sector, the ministry of industry and trade, the ministry of environment and unions. The automotive industry has also now the obligation to produce labels indicating the CO_2 emission of each vehicle. This process should be extended to the building industry and applied to each construction. In the long term, the ISIS project should contribute to the implementation of a "Climate Plan" including several measures and attestation procedures applied to energy suppliers. Some negotiations should take place in the future on development of ethical funds and on the implementation of worldwide Social and Environmental Responsibility standards, although the French State has limited power on those matters.

Sources and References

http://www.plan.gouv.fr

OPEC Long-Term Strategy

Author:	Rafael Popper, rafael.popper@mbs.ac.uk, rafael_popper@yahoo.com
Sponsors:	Organization of the Petroleum Exporting Countries (OPEC) and Member Countries
Type:	Long-Term Strategy through Scenario-Approach
Organizers:	Algeria, Indonesia, Islamic Republic of Iran, Iraq, Kuwait, Nigeria, Qatar, Saudi Arabia, Socialist People's Libyan Jamahiriya, United Arab Emirates and the Bolivarian Republic of Venezuela
Duration:	2.5 years · Budget: N/A · Time Horizon: 2020 · Date of Brief Production: February 2007

Purpose

The OPEC Long-Term Strategy (LTS) is the result of a two and a half year process, led by deputy ministers of petroleum/energy of its member countries, aimed to produce a comprehensive analysis on future objectives and challenges as well as scenarios shaping the socio-economic development of OPEC members.

Entering the New Energy Era

In a global economy still heavily dependant on oil as one of the primary sources of energy, it makes sense to keep an eye on ongoing developments and long-term strategies undertaken by a cartel of producing countries, which controls over 80% of the oil supplies in the world, the Organisation of Petroleum Exporting Countries (OPEC).

OPEC members - Algeria, Indonesia, Islamic Republic of Iran, Iraq, Kuwait, Nigeria, Qatar, Saudi Arabia, Socialist People's Libyan Jamahiriya, United Arab Emirates and the Bolivarian Republic of Venezuela - supply around 30 million barrels per day (mbd), a figure which, according to Iran - second biggest producer -, puts the Organisation at "its utmost capacity". And given that existing oil reserves figures show that there is plenty of oil to meet global needs for several decades, the main challenge for the Organisation is that of deliverability and not availability. Within this context, in 2003 OPEC embarked on a two-and-a-half year process aimed to develop its Long-Term Strategy (LTS).

For doing so, the Organisation focused on major changes affecting the oil industry and identified major challenges and opportunities for OPEC Members.

The LTS process took a scenario approach (1) to design robust and adaptive images of the future of the oil sector, as well as (2) to draw strategies, which may allow OPEC to continue expanding both upstream and downstream investments in order to contribute towards a more solid foundation for the future market stability. Obviously, OPEC's efforts to tackle the global problem of energy supply should be recognised by the world, and consuming countries should maintain the security of demand, in return. However, the role of consumers and producers is not that simple. Both need to be aware of the risks and benefits of future developments in the downstream and upstream sectors as well as the potential opportunities and threats which emerge from new technologies, environmental regulations and growing concerns on issues such as climate change and global warming, etc.

With these as major guidelines, OPEC's LTS identified major areas where OPEC members can have leading role in the foundation of the so-called new energy era.

The Role of Oil in 2020

Based on the assumption that oil 'will remain the main fuel over the next 20 years', the LTS has taken a scenario approach to explore three scenarios:

- **Dynamics as Usual (DAU)**
  using current patterns of global economic growth
- **Protracted Market Tightness (PMT)**
  using higher rates of global economic growth
- **Prolonged Soft Market (PSM)**
  using lower rates of global economic growth

Several factors were considered as key shapers of the future oil demand: demographics; advances in technology; capital availability and trends in commodity prices; domestic policies and global trade developments; regimes; environmental policies; financial regulations; and international imbalances, such as current account and budget deficits. And given that major consuming countries' policies have also affected the oil demand with higher tax rates on oil products and more subsidies on alternative fuels - e.g. biofuel -, OPEC members perceived the need for a coherent and consistent strategy for the Organization. The LTS puts oil demand in Dynamics-as-Usual scenario at an average of 1.5 mbd increase by 2020, with 3/4 of it coming from developing countries. The Protracted-Market-Tightness scenario suggests the demand would beat DAU prospects by more than 5mbd whereas the Prolonged-Soft-Market scenario goes below DAU average by 7mbd. Such uncertain future for the oil demand represents a key challenge for both OPEC and non-OPEC oil producers given that the oil demand "could range by as much as 10mbd or more". The LTS thus looks at the whole supply chain from crude to product and points out that while the upstream sector - exploration, drilling, production - is practically under control in member countries, the situation in the downstream sector - distribution, marketing and refining - if "far behind" future oil demands, suggesting strategic partnerships were needed among members and between members and consumers.

Key Features of OPEC's LTS

- **Promoting Fair & Stable Prices:** The LTS recognises that "extreme price levels, either too high or too low, are damaging for both producers and consumers", therefore it proposes that OPEC Members become "more proactive under all market conditions". Unstable prices do nothing but putting in danger the sustainability of supply as well as the security of demand.

- **Monitoring Economic, Technological & Political Developments in the Oil and Other Key Sectors:** The LTS recommends the use of so-called ´leading indicators` to monitor economic downturns and upturns affecting the oil demand and supply. However the process should be extended to policies and technological developments in other key sectors in order to measure possible impacts on the oil sector.

- **Promoting Timely and Sensible Plans for Capacity Expansion:** Capacity expansion investments are normally affected by uncertainties concerning the future oil production in OPEC countries. Therefore big efforts would need to be made in order to reduce the burden of risk in making investments, especially in the downstream sector.

- **Encouraging Consuming Countries to Increase Investments in the Downstream Sector:** The LTS considers that consuming countries and international oil companies have the main responsibility for investing in the downstream sector. As pointed out by several analysts, the newest refinery in the USA (the world's major oil consumer) is about 30 years old, despite the uninterrupted growth of demand for oil products there and worldwide.

- **Strengthening RTD Cooperation Among Members and Between Members and Other Actors:** The LTS stresses the need for stronger partnerships in both upstream and downstream scientific RTD among members and with international organisations, companies, etc.
- **Promoting the Development of Technologies that Address Climate Change Concerns:** The LTS also makes emphasis on the need for technology-based responses to air quality and climate change problems. Successful examples such as the carbon dioxide capture and storage technologies - e.g. enhanced oil recovery - would improve the environmental credentials of OPEC Members.

- **Promoting the Application of Advanced Upstream Technologies:** The LTS urges OPEC National Oil Companies to promote cooperation in activities aimed at sharing technology, knowledge, and experience, in particular for the application of advanced upstream technologies. Among the potential benefits of cooperation in exploration and development activities are: reducing costs, increasing recovery rates, and widening frontiers, thus increasing competitiveness.

- **Promoting a Fair Rule of Common but Differen- tiated Environmental Responsibilities:** The LTS advocates for a fair rule of common but differentiated environmental responsibilities. In doing so, OPEC should play a stronger role in making the international community fulfil its obligations with developing nations, for example:
  - minimising the adverse effects of environmental regulations and measures on fossil-fuel exporting developing countries;
  - promoting economic diversification;
  - transferring technology; and
  - building capacities.

- **Promoting Deeper Dialogue Among Oil Producers, and Between Producers & Consumers:** The LTS suggests OPEC Members become more active in trade-related discussions and at the same time use their natural resources as a comparative advantage for improving economic and social development. The LTS also recognises the need for deeper dialogue among producers and between producers and consumers. Several key issues have emerged as central topics for those discussions:
- market stability;
- security of demand and supply;
- upstream & downstream investment;
- upstream & downstream technologies, among others.

Besides the producing and consuming countries, several other stakeholders should also take part in this process, for example: regional organisations - e.g. European Union), bodies of the United Nations system, the International Energy Agency (IEA), the International

Energy Forum (IEF), etc. The presence of observers - non-Members producing countries - in OPEC ministerial meetings is regarded as important and strategic given that the Organisation is considering an expansion of Members and Associates.

- **Stressing the Positive Role of OPEC in the World:** The LTS highlights OPEC's role in supporting oil market stability, and laments the existence of preconceptions and misunderstandings on this matter. In this regards, key factors impacting on the oil prices such as speculation in the futures market, geo-politics and natural calamities were seen as far beyond control of OPEC members.

Asia's Growing Interest in OPEC

In his closing remarks during the Third OPEC International Seminar "OPEC in a New Energy Era: challenges and opportunities", September 2006, Dr. Edmund M. Daukoru, President of the OPEC Conference and Minister of State for Petroleum Resources in Nigeria, stated that:

"A changing pattern in the dynamics of oil demand is being witnessed today, with a geographic shift in growth patterns from the OECD countries to emerging Asia, China in particular. This growth will be primarily driven by the transportation sector".

At the Seminar, similar remarks made by Dr. Guoqiang Utang, Ambassador to Permanent Mission of the People's Republic of China to the United Nations and other International Organizations in Vienna, portrayed OPEC as *"a major force in stabilizing the world oil market"*. He also recognised that *"China is ready to enhance the cooperation with OPEC member states and other countries or regions in the world by moving into a new era of comprehensive, mutually beneficial and diversified international energy cooperation".*

EU's Energy Dialogue with OPEC

Since 2004, the European Union (EU) and OPEC have established the so-called Energy Dialogue, whereby meetings and workshops are organised to discuss energy policies and possibilities for cooperation. And, within this framework, Dr. Heinz Hilbrecht, Director for Conventional Energy Sources, at the Commission of the EU, presented in September 2006 various key goals and instruments of the EU's external energy policy, which include partnership with producers, transit countries and other international actors.
In this respect, the EU policy sees OPEC-EU Dialogue as a mutually beneficial initiative, which contributes to increase security and predictability in the market, "thus paving the way for the necessary long-term investments". And, according to Dr. Hilbrecht, the EU's "dialogue with OPEC is developing towards several directions... And cooperation on a number of issues is reviewed:

- the first of these issues relates to the energy policies adopted by both sides and their impact on oil markets - demand and supply;
- the second concerns investments in the refining sector and their impact on crude and product prices and volatility; and,
- the third issue is climate change and carbon capture and storage technologies".

Implementation of OPEC's Long-Term Strategies

Since the publication of OPEC's LTS, the Organisation and its Members have undertaken several actions in line with the LTS, some of these include:

- **Projects to build new refineries.** Several countries began refinery-building projects - Algeria, Nigeria, Kuwait, Saudi Arabia, and Venezuela. These initiatives are coherent with features 3 and 4 (see above) of the LTS.
- **Conferences and workshops to discuss key developments in the sector**. In December 2006, OPEC and the EU organised a two-day Joint Workshop that focused on the following two questions: *Do the prices of futures influence the prices of the underlying markets?* And, *Does the futures-based pricing system create too much price volatility?* The workshop helped both OPEC and the EU to better understand the issue of the speculative financial markets impact on the price and volatility of oil, thus relating the event to Features 1, 9 and 10 of the LTS.
- **Projects in the upstream sector.** Given the number of OPEC Members and given that the upstream sector - exploration, production, etc. - is rather broad, on this point two examples from Venezuela will be used to illustrate how current investments are aligned to Feature 3 of the LTS:
    - On exploration & certification investments: *"the Magna Reserva project that aims to quantify and certify Venezuelan reserves [...] will add approximately 235 billion barrels of oil [...] to the already proven reserves of 77bn b, thus making Venezuela the country with the largest accumulation of liquid hydrocarbon reserves in the world, with an approximate total of 312 billion barrel."*
    - On production investments: *"In Venezuela, the combined investment (2006–2012) is expected to be close to $60bn, with the focus*

on increasing production capacity from 3.3m b/d today to 5.4m b/d by 2012."

- **Energy Dialogues with key regions and countries.** OPEC has institutionalised the so-called Energy Dialogue with key regions and countries, such as: the European Union; the Russian Federation; and the People's Republic of China.
- **Regular bulletins, reports and databases.** OPEC regularly publishes statistical bulletins, reports and news on its web site. The Organisation is also building a comprehensive database to track global production and trade in the oil sector. These and other policies reinforce Feature 2 of the LTS.
- **Efforts to achieve fair and stable prices.** In a 2006 interview made by OPEC Editor, Dr. James Griffin, to the Venezuelan Minister of Energy and Petroleum and President of Petróleos de Venezuela, Dr. Rafael Ramírez, when asked for a fair and sustainable price going forward, Ramírez said, *"geopolitical factors; particularly the situations in Nigeria and Iran and a bottleneck in refining capabilities, need to be taken into consideration..."* In relation to fair prices he suggests that *"somewhere around $50 plus for a barrel, but who knows? What happens if Iran suffers supply disruptions because of geopolitical events? Just imagine we could be looking at $100 a barrel! It needs to be remembered that you cannot demand stability in the markets when you introduce instability."* Having said so, it is clear oil price stability does not only depend on producing countries pumping more or less oil. There is a need for a global commitment to avoid certain geo-political events from happening. In this sense, public statements such as the one above are in line with Feature 3 of the LTS.

Conclusions

The OPEC's LTS process made use of Scenario-Approach to identify key areas where *"OPEC Members, both as individual sovereign nations, as well as members of an Organization, can support their own pressing needs for socio-economic development, while playing a vital role in the international community".*

While the process is more likely to resemble a strategic planning exercise, certain characteristics, such as the long-term perspective, pragmatism, open and inclusive dialogue have caught the attention of foresight practitioners, thus making it eligible for the preparation of this EFMN Brief.

Sources and References

- OPEC (2006), OPEC Long-Term Strategy.
- OPEC Bulleting – January 2007.
- OPEC Bulleting – May/June 2006.
- OPEC Bulleting – October 2005.
- http://www.opec.org

Changes in German Production and Demography - the Supporting Role of ICT

Authors:	Agnes Pechmann, pechmann@dialogik-expert.de		
Sponsors:	German Federal Ministry of Education and Research		
Type:	Single issue		
Organizer:	Institute of Industrial Engineering and Ergonomics (IAW) at the RWTH University Aachen Asli Sagirli, a.sagirli@iaw.rwth-aachen.de		
Duration:	2004-2005	Budget: € 60 000	Time Horizon: Mid-/long-term

Purpose

The automobile industry is one of the most important industries in Germany and one of the key areas for R&D. To hold this position the industry has to face two challenges: 1st, changing parameters in and for industrial production like minimizing the time to market or shortened product life cycles; and 2nd, demographic change. The purpose of the study was to identify need for action and to present sub-sectors in which ICT could take a supportive role for industrial production.

Changes in the production sector

The demographic development in Germany and other Euro¬pean countries is dominated by two trends: The rising average age and the decreasing population. In consequence, the number of elderly employees is going to increase constantly. Thus, the recent staffing policy of releasing employees 50 years and older into early retirement respectively unemployment is inadequate. Particularly innovative industries like the automobile industry have to meet recent and future requirements of integrating elderly employees.

Germany's industrial workforce is growing old

In the automobile industry the challenge of planning industrial production systems, today and in the future, consists of

- preserving the physical and mental performance of employees,
- integrating the increasing number of older employees,
- adapting the production systems and processes to the changing requirements and
- supporting these changes by new information and communication technologies.

Researchers of the project «Development of new Information Technologies to adapt to changes in production and demography» analyzed the upcoming demographic change. Furthermore, the changes of production within the automobile industry were identified. The respective consequences on the work system can thus be elaborated and further needs for action can be derived. The focus of this project was the supportive role of information and communication technologies (ICT) in order to maintain efficiency and effectiveness of the production system.

Auto industry takes part in the foresight process

The study consisted of three phases:
Phase 1: Analysis of requirement
Phase 2: Development of a design matrix for ICT
Phase 3: Evaluation of the design matrix

The "analysis of requirement" phase consisted of two work packages - one concerning changes in production and one concerning demographic changes. Both work packages started out with developing scenarios in each field.

In the work package "changes in production" the second step consisted of specifying requirements and areas with need for action. In the third step implementation possibilities were identified and the results were evaluated.

In the work package "demographic change" the second step consisted of categorizing employee groups according to typologies of the social sciences and by using "Time worked in lifetime". In the third step these results were also evaluated.

The scenario development for "changes in production" was done in the framework of a one-day future workshop with a focus on mid- and long-term timeframes. The experts of the workshop were representatives of the automobile industry, mainly from OEMs and suppliers and from production areas as well as from human resources departments. The results of this future workshop were three scenarios, a worst-case, a best-case and a trend-scenario. The scenarios included technological, personnel and organisational factors. The scenarios in the work package "demographic change" were based on trends and findings as found in literature. The three types of scenarios were built based on those findings.

Interviewing experts from industry and sciences helped to evaluate the results of both work packages. In addition to this, the results of the work package "changes in production" have been compared to activities started and planned at one OEM and one supplier.

In the second phase, a design matrix for new information and communication technologies was developed. Recommendations for the design and functions of new tools in the category of ICT were worked out based on the results of the first phase. The following aspects were considered:

- Changing demands due to change in production technology and demography
- Short-, mid- and long-term intervention time frames
- Work force typologies.

The team presented the results in a so-called design matrix.

In phase three, experts evaluated the results presented in the design matrix during workshops and interviews. The content of the matrix was reassessed according to the feedback.

The validated design matrix

Scenarios for two different areas were developed and resulted in the design matrix for ICT. Some trends and aspects of the scenarios are presented in this brief.

Characteristics of the production scenarios
The main scenario results, validated through an expert workshop and interviews, are shown in the above table. The results are organized by the three fields: technology (T), organisation (O) and personnel (P) for worst case, best case and trend scenario.

Trends in the automobile industry
The number of Original Equipment Manufacturer (OEM) will be reduced because of relocating production to suppliers. The remaining production will be characterized by high technology. The permanent staff will be highly trained and will be complemented to a large extend by temporary workers which will respond to the dynamic manpower requirements

Demographic scenarios
The main results/characteristics of the demographic scenarios are given next page:

Demographic change happens below the level of perception, it occurs too slowly to become apparently visible in a short-term context. Currently a shortage of highly qualified labour - due to demographic changes - is not obvious in companies. Though it has been a topic in the media, company representatives have only been confronted with the consequences of it by discussing the scenarios. A major problem in handling demographic change is that there is no short-term solution. New competencies and company-

	Worst Case Scenario	Best Case Scenario	Trend Scenario
T	Variant-rich products, individualization, and small-series production Declining degree of mechanization in processing and assembling	High degree of interplant cooperation	Use of ICT in planning and coordination activities
O	Outsourcing in foreign countries and high degree of cross linking Restriction of German core business to development and distribution	Team and project work pattern in indirect work areas and across plants Elderly employees as key personnel in development and construction Parts of production is shifted from OEM to suppliers	Tayloristic work organization especially in production
P	Polarised profile in the labour skill structure Brain drain abroad Early retirement of older workforce	High degree of temporary labour, low degree of permanent work force Variation in labour utilization Labour specification includes willingness and capability to learn, flexibility, mobility and multilingualism Bundling of competency types	Shortage of highly qualified labour Modular system of advanced training with shortened basic training Diversity as strategic resource

Influencing factor / descriptor		Worst Case Scenario	Best Case Scenario	Trend Scenario
Structure of population	Birth rate	⇢2,1	⇠1,4	1,4
	Life expectancy (years)	⇠83	⇢83	~83
		⇠88	⇢88	~88
	Migration	⇢ 200.000	balanced	+ 200.000
Labour market and economy	Employment ratio (%)	⇢79,3	⇠79,3	@79,3
		⇢65,2	⇠65,2	@65,2
	Work age-limit	70 years	65 years	67 years
	Education level	Balanced on high level	Shortage of highly skilled labour force	Slight short¬age of highly skilled labour force
	Investment	High investments in Germany, technological progress	Low investments, brain drain	Stagnating investments und limited technological progress

internal learning processes allowing continuous adaptation to the changing conditions are needed.

Recommendation for action to handle demographic change by staffing policy
"Excess of age" is not seen as an independent problem for operational business nor is it categorized as currently important. "Aging" is not independently significant, if addressed at all, it is handled in close connections to other aspects in regard to operational benefit considerations.

In order to minimize risk, companies need to offer alternative career options to improve intra-company flexibility and mobility for young qualified personnel and at the same time to improve the company's recruitment chances.

In summary, for staffing policies of the future the following demands are seen:

- Permanent exchange between the generations and age diversity as an integrated goal
- Safety and health, recruiting, personnel development need an aligned, networked goal setting
- Change from only short-term to short-, mid- and long-term personnel planning is needed (up to 20 years)
- Inter-generation contracts to balance age specific demands to improve employer attractiveness

What ICT has to offer?

Looking at future development in production processes, not all are related to an aging population. Nevertheless, those developments have to be handled by an aging working population. The main purpose of the study was to identify options where ICT is able to support the adaptation process to these developments. In the table below the specification for ICT as support instrument are shown, again for the three different scenarios in the areas of technology (T), organisation (O) and personnel (P).

ICT as support instrument (below)

Augmented reality, artificial intelligence and simulation to support new production schemes

Qualifying employees to meet future lack of highly qualified labour is only one way to address the problem; designing technology, which can be utilised by non-specialists, is another way. The challenge will be to enable ICT tools to adapt themselves according to the abilities of the single employee.

	Worst Case Scenario	Best Case Scenario	Trend Scenario
T	IT-support for planning and controlling, and material flow ICT to mini¬mize physically exhausting activities	IT-support for close coop¬erative bonds Modular design of new tech¬nologies to ensure usability and compatibility	Standardisa¬tion of external in¬terfaces
O	Real-time in¬formation flow	IT-support to handle flexi¬ble working time models	ICT as con¬tinuous instru¬ment for quali¬fication
P	ICT as inte¬grated ele¬ment of teach¬ing and learn¬ing	Ensuring the transfer of gained experi¬ence (know how) IT-support for spatial mo¬bility	Independent of target group, self explaining communication support

Augmented reality, artificial intelligence and simulation should be able to meet most demands looking at the ICT demands identified in the above table. An example: The capability to cope with the raising demand for flexibility and multi-variants products can be improved through better IT-support for planning and controlling, and material flow - point 1 in the table - by simulation of the whole integrated production process. This capability can even be further improved by applying artificial intelligence according to the needs of the employee involved.

Almost all listed demands can be met by ICT through the fields of augmented reality, artificial intelligence or simulation or through a combination of two of these. Two demands, though, will not be met by the covered ICT technologies: the information flow in real-time - point 6 - and standardization of external interfaces - point 3.

The information flow has to be real-time in order to meet the communication demand of strong cooperative networks. It is restricted to technical information even if augmented reality allows for a continuous information flow in real-time. Network communication requires relevant and exhaustive information. A reduction of complexity is therefore needed, but the ability to do so is not in the scope of augmented reality.

Standardization of external interfaces is a major prerequisite for the needed information flow in-between networks. For this task, the covered technologies are not expected to have the potential to cover this. Nevertheless, both points must not be disregarded.

What could/should be done and what is unlikely?

Augmented reality (AR)
Urgent need for research regarding AR is seen in further development of identified deficits like avoiding symptoms of fatigue, to raise the usability and demands induced by demography changes - aging and/or less qualified work force. True-to-life illustration in real-time with a situative and cooperative overlay of information has to be made possible. This is particularly needed to fully use the potential of AR as an integrative element in teaching and learning, as an instrument for qualification and for ensuring spatial mobility.

Simulation
The physical model of humans needs to be further developed. The modelling and simulation of mental structures, especially in the context of thinking and behaviour patterns in production areas is a main research topic. A starting point could be the area of human deviances and its influencing factors, impacts on the working process and correction possibilities.

Artificial intelligence
The different application areas of artificial intelligence, e.g. robotic, intelligent knowledge management, user interfaces and clothing have in common that their stage of maturity does not yet allow industrial application. Though the potential is high, the costs to bring it to industrial application are high as well. Especially in the Germans automotive industry, with its SME structure, the capability for financial investments from SME-side is limited. The exploitation of the possibilities is therefore unlikely.

The situation can be compared to the development of computing during the last 30 years. As today in ICT, 30 years ago it was not imaginable how and to which degree the computer technology would find its way into daily life. Today, computing is a must in our lives.

Sources and References

- http://www.iaw.rwth-aachen.de/index.php?article_id=20&clang=0&projid=45
- http://www.innovationsanalysen.de/de/projekte/iuk_demograf.html

Iris Futures – Foresight in the Brussels Capital Region

Authors:	Maya Van Leemput		
Sponsors:	Prospective Research for Brussels of the Brussels Capital Region		
Type:	Territorial study of foresight		
Organizer:	Vrije Universiteit Brussel		
Duration:	2005-2006	Budget: € 120 000	Time Horizon: Open

Purpose

Iris Futures (IF) is a study of prospective activities and futures thinking in Brussels conducted at the Vrije Universiteit Brussel in the framework of 'Prospective Research for Brussels'. The point is not knowing or predicting the future of Brussels but to create an overview of existing prospective activities in Brussels as well as of different attitudes towards the future in Brussels.

Exploration of foresight in the BCR

Iris Futures has an intentionally open and explorative line of questioning. The initial research question was: What is the range of systematic consideration of, and action on, the future taking place in the Brussels Capital Region?

In the first stage different uses of the term foresight and a range of definitions is explored. Three important characteristics are, reference to the future or futures, foresight also has an important action related dimension. Participative or collective nature. The IF exploration of foresight in Brussels takes into account both those fully fledged foresight exercises that display all three of the above characteristics and those future oriented activities that do not. The first have been termed 'characteristic foresight' activities or FA in short and the second 'future oriented' activities' or FO.

The central research question then, is rephrased: What is the range of characteristic foresight and future oriented activities taking place in the Brussels Capital Region?

IF takes into account both the activities themselves and the organisations that conduct these activities. To open up possibilities for further future oriented work in Brussels an interpretative approach for the futures dimension of a range of organisations is developed and barriers and motivations to futures oriented work are discussed.

Listing activities, organisations and interviews

A single researcher conducted the two-year study. An overview of FO and FA that took place in organisations and institutions of Brussels in the years 2005 and 2006 is added to by 82 interviews on future oriented work in Brussels. The data for the analysis was taken from these interviews and materials pertaining to the future oriented activities in the overview to identify some of the recurring elements in representations of the future in Brussels.

Sixty activities and 120 organisations

Listed for this study's analysis are sixty activities - future oriented and characteristic foresight. These all took place in Brussels in the years 2004, 2005 and 2006. The list is not intended as an exhaustive overview, but does include a broad range of activities by four actor types: public, private, non-profit and learning organisations. The titles and the names of the initiative takers of eight FA and fifty-two FO are the primary identifiers of each activity.

Eight characteristic foresight projects (FA)
(See next page)

The duration and frequency of the activities were limited. Most activities were one-off events or projects. With the exception of the larger FA, few lasted longer than 2 days. Only four were part of regularly recurring programs.

Four themes receive attention: urban infrastructure, creativity, learning, and welfare. An 'other' category was also created and the allocation of one theme to an activity did not exclude the allocation of another. Half of the activities in the overview are related to the theme of urban infrastructure but none of the FO or FA focused exclusively on bricks and mortar. They combined thinking about infrastructure with questions of quality of life, welfare and wellbeing. The language of planning, activism and conjecture is evident within this theme. Almost half of the organisations in the list and fourteen activities were related to creativity one way or another and the overview contains 50 organisations that focus on employment, housing, education and care. These welfare related topics received attention in a third of all the activities. The BCR authorities have taken the initiative for several extended now activities in this area and a range research, policy support and deliberation organisations of organisations tied in with various levels of government are involved. Thirty-nine organisations are involved in learning, 13 of these are learning institutions, the universities and other institutions of higher education. Not just universities but also organisations from the technology-depended library sector and activist organisations have payed attention to this theme in 14 separate activities.

Zinneke Parade 2006	org	Zinneke Parade
	Theme	creativity
	Time horizon	51-150 years
	Geographical scope	BCR
	number of participants	500+
	prominence	high
Empreinte écologique	org	ETOPIA
	Theme	Other
	Time horizon	36-50 years
	Geographical scope	BCR & International
	number of participants	50-200
	prominence	low
Après le pétrole : un monde a inventer.	org	ETOPIA
	Theme	Urban infrastructure
	Time horizon	11-15 years
	Geographical scope	International
	number of participants	50-200
	prominence	high
Mobil2015	org	BCR
	Theme	Urban infrastructure
	Time horizon	5-10 years
	Geographical scope	BCR
	number of participants	350-500
	prominence	high
MIVB 2020	org	MIVB
	Theme	Urban infrastructure
	Time horizon	11-15 years
	Geographical scope	BCR
	number of participants	50-200
	prominence	high
Masterplan 2015	org	Port de Bruxelles
	Theme	Urban infr. and welfare
	Time horizon	5-10 years
	Geographical scope	BCR & part of Brussels
	number of participants	50-200
	prominence	high
Regards prospectifs sur l'associatif bruxellois	org	CBCS
	Theme	other
	Time horizon	5-10 years
	Geographical scope	BCR
	number of participants	0-50
	prominence	high
Brussels Capital of Europe.	org	Berlage students
	Theme	Urban infr. and creativity
	Time horizon	36-50 years
	Geographical scope	BCR & Europe
	number of participants	500+
	prominence	high

The time horizons of the activities are relatively short: less than 15 years and effectively never more than 100 years ahead. Most of the projects are reported to have medium-term horizons of between 10-15 years. There where two FA with a time horizon of more than 50 years among which the he Zinneke Parade aiming for 2106 with floats depicting 2058 as well as 2250.

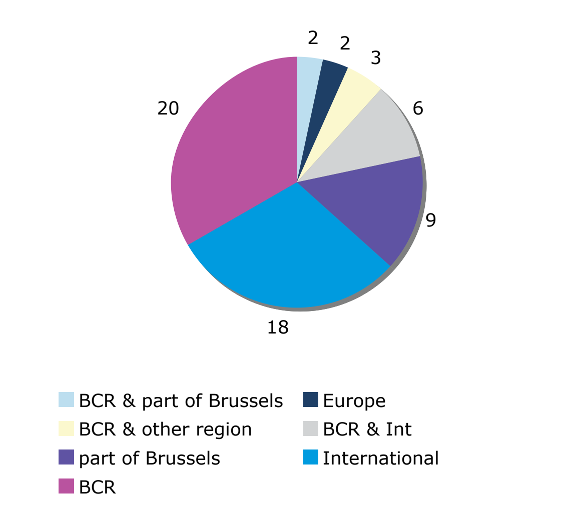
For describing subject matter, instead of a set of pre-determined keywords, tags were used that reflect wording and terms from documents and conversations about the listed activities. Each activity received at least two tags. This resulted in a collection of 72 tags. Different tags sometimes refer to closely related concepts and ideas. For example, both work and employment appear as tags, both multi-culturality, interculturality, both integration and social cohesion appear in the list, avoiding the reduction of the subtleties of language that express diverging frames of reference. Tags to do with mobility and urbanism, city renewal and ecology appear most in relation with the 60 activities in the list.

The geographical scope of the FO and FA is specific to the BCR. Only activities initiated by organisations that reside in Brussels and are active on the territory of the BCR are listed. The territorial and the jurisdictional scope of these actors is impacted on by the Belgian institutional organisation and the role of Brussels within it. Taking the reasoning of the intricate Belgian system of jurisdictions divided over communities as well as regions into account, only those government and public administration activities of the region - and smaller scales - were within the scope of the study. The three other levels of government present in Brussels - federal, regional, European - remain to be studied elsewhere. However, activities organised by organisations from Brussels in Brussels can treat issues in a community, national or international context.

The significance of the future orientation of 7 out of 8 the 'characteristic foresight' activities are high. Almost half of all the activities are categorised with a low prominence for their future orientation and only a small share of their time/space allocated to it. The remaining half is divided equally between medium and high significance.

The prominence of the future orientation of the listed activities is determined by the way futures questions are put at the forefront in communication on the activity, the use of timelines, visual images of the future or rhetoric references. The share of the activity that focuses literally on the future further indicates significance. Time allocated to futures activities within organisational schedules is problematic to ascertain. Programmes and end products of the activity, the number of speakers or the number of participants were the two most useful indicators.

Geographical scope of the FO and FA



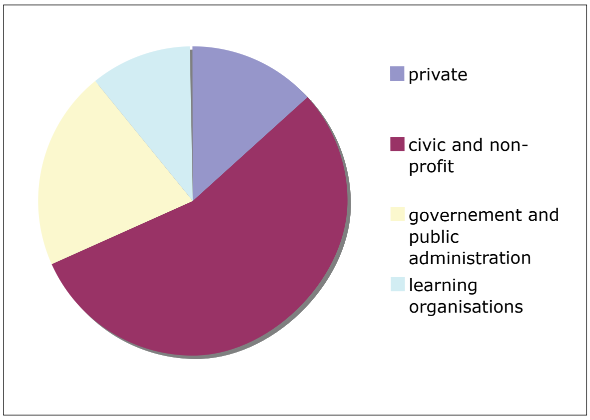
Very little specialised methods are being used in the FO, the emphasis lies with debate, discussion or deliberation. In the FA more consideration and skill goes into the choice of methods. Outside facilitators or researchers are called in for their methodological expertise as well as for their topical knowledge and contributions. In programmes and reports of activities debate and expert opinion appear as the two top methods.

Only a few outputs have been conceived as stand-alone presentations. Exceptional outputs from a handful of creative projects include the Zinneke Parade and BNA-BBOT's Blinddate 58 audio-archive. Policy recommendations and priority lists were the end product of no less than 26 activities from our overview. These are especially important in the larger FA but also in smaller FO from interest groups or special interest organisations.

The numbers of people involved in the activities and the types of audiences/participants vary. All together, the 60 activities reached at least 8500 people. The 2670 people taking part in the Zinneke Parade are the largest actively participating audience reached by any of the activities. The estimated 100.000 viewers spread out in the streets of Brussels on the day of the parade represent a considerable audience. One research project at the Vrije Universiteit Brussel, reached more than 1400 people with its survey - with three explicitly future oriented questions - of EC functionaries alone. More than three quarters of the activities were aimed at or at least open to the general public. Thirteen were directed to a local public and about a third of the activities were directed to special interest lay audiences. Private companies and members of he research community were included in almost half of the activities.

The organisations listed for Iris Futures have been organised in to five different layers of future orientation. Those not up for consideration fall into 'layer nil'. In 'layer one' organisations are found that are involved in the implementation of forward looking views and that are 'en route'. Only a couple of examples of these types of organisations were retained for the analysis. In 'layer two' includes an important number of organisations involved in 'extended now planning', limited to about 5-6 years in many contexts. In 'layer three' have an implicit or secondary formal future orientation. Fifty-eight organisations listed in IF are found in 'layer four' having formal futures orientations or being involved directly in FO. 'Layer five' covers the organisations that have initiated or partnered in the eight FA in the IF overview.

BCR organizations involved in FO and FA by actor type



Impact and Policy Implications

There is good foresight potential in Brussels. No less than eight characteristic foresight projects and 81 organisations involved in forward-looking activities were found. Nevertheless there is room for improvement. The most important barriers and motivations for foresight in the BCR are listed in this study and suggestions for approaches to stimulate FO and FA are tentatively formulated.

Uncertainty features both as a barrier and as a motivator and concerns both the survival of organisations as more general uncertainties about trends and evolutions. Policies to encourage long-term thinking will need to address both types of uncertainty without aiming to undo them.

Institutional organisation has a great impact on future oriented activity in Brussel, due to the city's place in the complex Belgian political landscape. Institutional fragmentation constitutes an important barrier to pro-active, integrated foresight. Two basic attitudes have been found on this issue. One regards it a pre-condition for this issue to be resolved before headway can be made with foresight in Brussels. The second starts from the idea that 'this will never change' and it is neccasary to 'work with what we've got'. In relation with the territorial jurisdiction of the various levels of government in Brussels, the points that the BCR has little leveraging power over what takes place in the neighbouring regions and it shares its territorial jurisdiction with 19 municipalities have been made by many respondents. Close collaboration, good networking and joint efforts constitute the most widely supported response to this barrier.

The impact on FO and FA by the time horizon of political mandates of course is not typical of Brussels alone. The experience of those close to government rule as well as those who dependent on ever-changing policy orientations for the funding of their activities is that the time horizon of political mandates increases uncertainty and therefore the potential for action upon the future.

Closely related to the need for collaboration and joint efforts across levels of government, communities and themes, is the question of trust. While a lack of trust is an important feature, inter-organisational cooperation in the framework of 'characteristic foresight' has been reported to bring actors closer together.

Most of the listed organisations take part in active networks. The future orientation of the partners in these networks impacts on that of each of the individual organisations.

Time pressure and the knowledge of foresight methods and objectives are also reported to impact significantly. There are few foresight specialists in Brussels - other than those active at institutions separate from the BCR - and there is little theoretical understanding or practical knowledge of foresight. The large majority of respondents were not familiar with the idea of foresight, even among those that have participated in or initiated some of the smaller FO.

Fifteen respondents were well informed on the principles of foresight and the methods available for its implementation. All have practical experience with concrete foresight exercises and the large majority is in favour of its implementation on the social level and recognises its use value at the organisational level. Also among less well-informed participants positive estimations of the need for a forward-looking practice were found.

The authorities can play an important role. The large majority of respondents have expressed some interest in conducting foresight in the future, so that efforts to encourage this will find fertile ground. The issues they have taken up in the past are the issues that most respondents are aware of, so that it becomes clear that the BCR authorities can lead by example. If the time horizon of their outlook increases, that of their partners and other organisations active on the BCR territory is likely to increase also. Respondents place responsibility for FO and FA most often with public policy-makers.

The set-up of a foresight programme or a large-scale characteristic foresight exercise is suggested. The scope of such a programme or exercise should reach beyond the formal jurisdictions of the BCR and not be limited to a single issue and take account of the main barriers to foresight. It would need to refer back to efforts already made in the BCR context as well as in the international context.

From the IF overview it becomes clear that most successful foresight exercises have been conducted in the context of organisations were good foresight skills are present within the organisation itself. The conclusions of the study suggest that the BCR authorities set up a transversal unit to support its forward-looking practice. It also emphasises that the challenge is to look at a range of possible futures for Brussels and that singular views on the future should be avoided. The complexity of the issues at hand and the inherent potential of diverging ways to tackle these issues need to be accepted. Emphasis is placed on the plurality of futures, on the relevance of the examination of possibilities and on the need for open futures.

Sources and References

Borra, B, Declerck, J, Ryan, M, et al (eds). (2006) Brussels Capital of Europe – Urban Form , Representation, Architecture. Rotterdam, The Berlage Institute.

Brussels Hoofdstedelijk Gewest-CET (2005). Contract Economie-Tewerkstelling Brussel 2005-2010.

Brussels Hoofdstedelijk Gewest-Directie Studies en statistiek. "Mini-Bru".

Roesems, T., Perdaens, A. (2004). Samenvatting 9de Armoederapport Brussels Hoofdstedelijk Gewest Deel 1. Brussel, Observatorium voor Gezondheid en Welzijn Gemeenschappelijke Gemeenschapscommissie van Brussel-Hoofdstad.

Van Boven, G. (2004-2005). Culturele collaborati(e)(on) culturelle te/à Brxl. Brussel, Hogeschool voor wetenschap & kunst departement toegepaste taalkunde.

Vandermotten, C., Van Hamme, G., & Beys, N. (2004). Les évolutions économiques en région de Bruxelles-capitale et leurs impacts sociaux. Brussel, ULB-IGEAT.

Vanherweghem, J.-P. (2004). Het Jaarverslag 2004 van de Raad voor het Wetenschapsbeleid van het Brussels Hoofdstedelijk Gewest. Brussel.

ICT and Robotics in Agriculture and the Related Industries – a European Approach

Author:	Svend Christensen, Svend.Christensen@agrsci.dk
Sponsors:	Department of Agricultural Engineering, Faculty of Agricultural Sciences, University of Aarhus
Type:	A thematic brief focusing on the use of ICT and Robotics in agriculture and related industries
Organizer:	Standing Committee on Agricultural Research – Collaborative Working Group on ICT and Robotics in Agriculture and related Industries. Chairman Research director Svend Christensen, Department of Agricultural Engineering, Faculty of Agricultural Sciences, University of Aarhus
Duration:	May 2005 — Budget: NA — Time Horizon: 2020 and beyond

Purpose

A Collaborative Working Group (CWG) under the Standing Committee for Agricultural Research (SCAR) has been formed to raise awareness on the research and development within the area of ICT and Robotics and to advise the European Commission. The CWG will assist in putting this field of research on the agenda in a European context as well as creating consensus among the most important stakeholders. This is done through dialogue and increased member state collaboration achieving synergy and creating optimal conditions for further development.

Assessing the Use of ICT & Robotics for Agriculture in Europe

The vision of the collaborative working group in ICT and Robotics is to shape and focus the research and development in ICT and robotics for the agriculture and related industries and provide a basis for member state collaboration. The working group brings together existing networks, achieves critical mass, and provides optimal conditions for the European work in ICT and robots for agriculture and related industries.

Why ICT and Robotics for Agriculture?

There is a growing worldwide need for the development of innovative technologies applicable for biological systems according to the global demand for food, food quality, and the increasing awareness of the impact of agriculture on animal welfare and environment. This is accompanied by a significant potential in supporting the competitiveness of EU agriculture and related industries through mobilising research and innovation efforts on ICT and robotic technology.

New EU policies on traceability, food safety, agri-environmental and rural development have renewed the interest in ICT and robotics research as a solution to an efficient implementation of these policies. The policies are reflected in a demand by European agriculture and related industries for technological solutions: Solutions that can accommodate policy demands and provide competitive advantages in a market where increased consumer demands and environmental focus are on the agenda. There is a significant potential in supporting the technological development by mobilising research and innovative efforts on ICT and robot technology within the EU. The challenge is to support the emergence of biosystems management technologies capable of meeting environmental and ethical requirements while promoting efficiency and a healthy work environment. Biosystems management technologies that can e.g. enhance the surveillance of crop and animals thereby optimising the quality and output or technologies that can minimize the effect from animal waste - odour, gas emissions, leaching etc. - through a more efficient and precise handling of the resource. The knowledge bases that exist in the implicated research areas will through a closer cooperation and coordination be able to achieve a synergy that can create new innovative solutions in the applied research and production of the sector. The added value will be created through inter-professional network and the large growth potential of SMEs that can develop high-technological solutions in the cross field between biology and engineering, an area where the EU has the potential to take the lead.

Benefits Expected from Joint Agricultural Research

The fundamental technologies play an increasingly important role in European national strategic research priorities and should be expected to do so in FP7 as well. There is a considerable scope for increasing member state collaboration and many reasons for doing so, including:

- Agriculture and the food industry in the member states face largely the same problems, and often initiate research and development in ICT and robotics independently of each other to solve these problems. The member states can benefit from collaboration in R&D and by using each other's results.
- Increasing demands for traceability are a threat to the free trade of food products in Europe, unless common solutions can ensure an efficient use of ICT and robotics in the exchange of products between member states.
- Legislation related to agricultural subsidies, environmental regulation, traceability, food safety, etc. is largely enacted at the EU level and efficient support of these policies requires coordinated research on ICT support.
- The costs of research and development in the field of knowledge intensive ICT and robotics are very high. There is a considerable scope for improving the R&D efficiency by cooperation between member states.
- Different expertise, research data and research facilities exist in different countries so international collaboration would allow an integrated approach to R&D issues.
- Increasing the market presence through collaboration between member states will provide improved opportunities for profitable R&D in agricultural ICT and robotics.
- National funding of R&D in agricultural ICT and robotics are often insufficient and difficult to obtain. However, an increased international collaboration may well stimulate national funding as well.
- EU agricultural machinery development is under pressure from producers outside the EU and there is a need for renewed European focus on the next generation robotics solutions that support key EU policies.
- ICT and robotics will ensure the productivity and minimize the negative environmental impact of the sector.

Agricultural Research at EU Level

The Standing Committee for Agricultural Research – SCAR - was established by the regulation (EEC) No. 1728/74 of the Council of 27 June 1974 on the coordination of agricultural research. SCAR advises the Commission in the field of the coordination of research in agriculture. SCAR management was in the middle of 2004 transferred to the European Commission DG (Directorate General) Research and a new more flexible SCAR was introduced to enable better cooperation and coordination in view of the European Research area within the agriculture sector.

Towards a Knowledge-based Bio-Economy

The working group of SCAR proposed 11 themes for collaborative working groups - CWGs. Denmark is represented in 9 of the collaborative working groups – and coordinator of one: the CWG for ICT and Robotics in Agriculture and related Industries. Below is a list of the established CWGs for targeted actions:

- ICT and robotics in agriculture
- Utilisation of renewable raw materials for industry
- Sustainable livestock production from grasslands
- Mediterranean agriculture
- Agricultural and sustainable development
- Animal health
- Ecological networks and corridors
- Ecology for ecosystems & natural resources
- Development of sustainable agriculture in Baltic Sea Region
- Advanced Technologies for Climatic Control of Greenhouses and Livestock Housing
- Human alimentation & nutrition

The aim of the CWGs is to implement a Common Research Agenda in Europe in the field of agricultural research – where the term agricultural research is understood in a broad sense encompassing the so called 'fork-to-farm' concept, emphasising research for sustainable agriculture, and including biodiversity and rural development., thereby addressing topics within a concept of a "the knowledge based bio-economy".

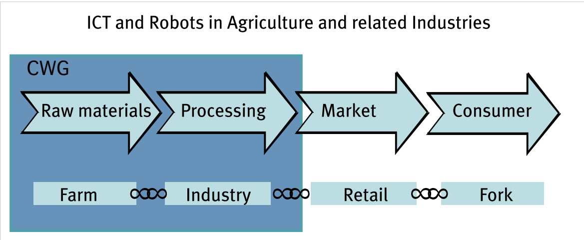
Focus area – ICT and Robotics

The area of the CWG is specified in the figure below. The work area comprises the areas of agriculture and food processing industry until the retail part of the food chain. The group is at present in the state of mapping the national research programmes, generic knowledge and projects within the area, and formulating the R&D themes on ICT and robotics in agriculture and related industries within the next decade. The work will help to focus the group and its future effort.

Members

Presently 18 representatives have joined the CWGs. Their members come from 11 nationalities in the EU and associated countries, 8 countries of which have contributed to the preliminary mapping of the R&D in the area.

Experts from Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Sweden and Switzerland form the basis of the group.



Mapping Research programmes

The national research programmes within the area of ICT and robotics in agriculture and related industries are very broad and often found within either agricultural or horticultural research programmes or more high technology or ICT-focused programmes. The national research programmes and strategies need to be examined more closely in order to step up the cooperation and coordination of research activities carried out at national level in the Member States and Associated States through the networking of research activities conducted at national level, and the mutual opening of national research programmes.

Projects on ICT & Robotics

The different national projects are mainly found within the area of ICT and concern areas as traceability, precision farming incl. positioning, data collection, and registration. There are fewer projects concerning robots and sensors. The robot technology projects are primarily on guidance and control issues. Sensor projects are divided into projects with the aim of reducing the use of pesticides or improving the indoor climate of livestock buildings.

More Generic Knowledge Needed

There are a great number of institutes that takes part in the knowledge within the area. What can be seen from the mapping is that the knowledge is very much dispersed on a national scale, and it is not possible to come to any conclusion based on the present material about the extend and importance of collaboration between institutes. Further studies should be undertaken to cover the entire European R&D stakeholders within the area – and the collaboration between them. To include a higher degree of industry driven R&D in the CWG the industrial stakeholders and organisations need to be examined and involved to a much more direct and greater extent than they are today.

Future Themes

Following themes and their objectives are the result of a process in the SCAR Collaborative Working Group within ICT and Robotics in Agriculture and related Industries:

Agricultural Product Quality Sensing and Documentation

The objectives of the theme are to include the whole production chain, managing and tracking, from raw materials to final products and the optimisation of logistics aspects and management, thereby increasing the value of the products by sorting out qualities that consumers ask for as well as to assure food safety.

Agricultural Information, Communication and Management Systems

The objectives are to foster the creation of open and flexible software architecture based on emerging large scale distributed internet technologies. The software architecture will facilitate the integration of the results provided by the studies in many disciplines including technology development for short-range wireless networks and RFID or MEMS utilizing RF technology, micro-sensing, high frequency technology, networks, human interaction technologies and media.

Precision Livestock Farming

The objectives are to integrate biological knowledge into ICT and robotics to survey individual animals or groups and use this information for management and decision support. Further objectives are the development of welfare promoting production principles in animal husbandry, e.g. through the use of new technologies for feed, milking, reproduction control and health surveillance.

Precision Crop Farming

The objective is to optimise in- and output for each sub area of the field to increase the total efficiency as well as eliminating or reducing the negative effects and impact on the environment thus increasing competitiveness for the agricultural crop production in the EU.

Monitoring Agricultural Environment

The main objective is to monitor the agriculture environment by identifying the most important factors effecting the environment, i.e. greenhouse gases, dust, pesticides, climate, as well as finding and developing measures taken to eliminate or reduce this negative impact.

Automated Agricultural Machinery

The objective is to address some of the key challenges in automation of agricultural equipment and to support the introduction of robotics in the agricultural domain. Autonomous robotic equipment that will reduce the environmental impact, increase precision and efficiency, and allow care and management of crops in new ways. The work will address the development of robotic systems that can handle the complex, dynamic and semi natural environment encountered in agriculture.

Future Initiatives for Food Safety and Sustainable Development

ICT and robotics are prerequisites for food safety and a sustainable development of future farming and the related industries, and the CWG activities will continue to support the overarching objective to increase coordination of national agricultural research programmes through the following sub-objectives:

- information exchange and best practice
- common strategic issues
- joint activities
- joint/common calls

The research funding organizations and providers of the collaborative working group agree that an **ERA-Net provides** a potential coordination instrument for joint activities and joint/common calls within the focus areas, but there are also promising possibilities in the work within **Technology Platforms and Common Research Projects.**

Sources and Reference

For any further information concerning the group please refer to Dr. Svend Christensen at **Svend.Christensen@agrsci.dk**

Or take a look at the SCAR net homepage:
http://ec.europa.eu/research/agriculture/scar/index_en.cfm

User Centered Innovation in Manufacturing

Authors:	Philine Warnke, Philine.warnke@ec.europa.eu			
Sponsors:	European Commission DG Research Industrial Technologies (G2)			
Type:	Thematic Foresight			
Organizer:	JRC IPTS, Philine Warnke			
Duration:	Feb 2006 –May 2007	Budget: € 325 000	Time Horizon: 2020	Date of Brief Production: June 2007

Purpose

'User Centered Innovation in Manufacturing' (UCIM) was investigating possible pathways towards user centred innovation approaches in European manufacturing industry with the following two main purposes:

Support the European Commission and the Manufuture technology platform to set priorities for the funding of research on industrial technologies that will underpin sustainable and competitive manufacturing in Europe.
Stimulate a wide stakeholder debate on the implications of user centred innovation for European manufacturing industries in order to raise awareness.

Integration of Users – a Challenge for Manufacturing Industry

Since a number of years the European Commission has used Foresight to define research-funding priorities in interaction with European stakeholders in the realm of industrial technologies. Two large-scale exercises have been looking into the future of European manufacturing industries. The Manufuture technology platform has been set up and developed a long-term strategic research agenda. Within this framework the UCIM project addressed a challenge for European manufacturing industry that was identified as of particular relevance within the previous work: The Integration of users as active partners in product and service innovation. This challenge, which is driven by changes in economy and society on the one hand and by emerging enabling technologies on the other is demanding substantial transitions in manufacturing industry that are not yet well understood.

Envisioning User Centred Innovation - The UCIM Approach

The UCIM project was pursuing the following objectives:

- Develop visions of user centred innovation approaches within European manufacturing industry that underpin sustainable and competitive manufacturing located in Europe.
- Identify elements that need to be developed in order to realise these visions - enablers & roadmaps.
- Recommend research funding and other policy measures needed to foster the roadmaps.
- Foster stakeholder debate and creative thinking on the matter through thought provoking input.

UCIM used a roadmapping approach to set up the structured stakeholder dialogue characterising Foresight. Special emphasis was placed on visualising ideas and concepts to initiate out-of the box thinking and creative debate. In a first step two pilot roadmaps on furniture and machine tool industry were developed. In the second phase the results were translated into a more general picture of manufacturing industry. The whole process was carried out in close interaction with stakeholders and experts involving the following steps:

- Literature review and analysis to identify emerging types of user centred innovation approaches.
- Pilot roadmap furniture industry:
    - Stakeholder interviews using imaginary future situations of user innovation (see figure 1).
    - Interactive stakeholder workshop to condense visions into scenarios and identify barriers and enablers.
- Pilot roadmap machine tool industry - same approach.
- Generalisation of sector specific results for manufacturing industry in interactive workshop.
- Validation of results and Identification of policy measures in support to enablers within interactive workshop.

All workshops were fed with illustrative material following from internal analysis and documented in detail often using imaginative visualisations (cf. figure 1&4). An interactive webplatform was used to moderate stakeholder debate throughout the project.

Figure 1: Fictive situation used to stimulate future oriented thinking in the UCIM stakeholder interviews

Involving Stakeholders

UCIM involved experts and stakeholders within three interactive workshops - each around 15 participants, around twenty face-to-face interviews and within an online web dialogue. For the two pilot roadmaps stakeholders from the two industries - furniture and machine tool - were involved together with researchers working on the various enablers. In the validation phase, policy makers and researchers dealing with innovation and consumer behaviour were involved. Currently the results are disseminated and discussed with a wider audience.

UCIM Management

A consortium of six European research institutes carried out UCIM with complementary competencies in innovation studies, Foresight methodology and manufacturing concepts:

- Centre for Knowledge Exchange - CKE, Ireland
- European Commission Joint Research Centre - Institute for Prospective Technological Studies - JRC-IPTS, Spain
- VTT Technical Research Centre of Finland - VTT
- Austrian Research Centre Systems Research - ARC
- Netherlands Organisation for Applied Scientific Research - TNO
- Strategic Design Scenarios - SDS, Belgium

DG Research, Industrial Technologies as a Specific Support Action – SSA - within the sixth Framework Programme, financed UCIM.

UCIM Results

The UCIM project was focussing on developing desirable visions and on stimulating debate and out of the box thinking. It placed less emphasis on identifying ongoing trends or likely futures in an exploratory manner. The core findings are incorporated in the typology of user innovation, the scenarios, roadmaps and policy recommendations.

Types of User Centered Innovation

As a base for the vision building a conceptual framework was developed distinguishing different types of user centred innovation.

The differentiation was done in two respects. A first distinction was made according to nature of activity required from both user and manufacturer. Involvement of users can focus either on the product creation of on the production (cf. figure 2). Secondly, we classified the approaches as to the nature of the innovation coming out of the joint effort which can be either incremental or radical innovation directed towards either a specific product or a whole product type (cf. figure 3).

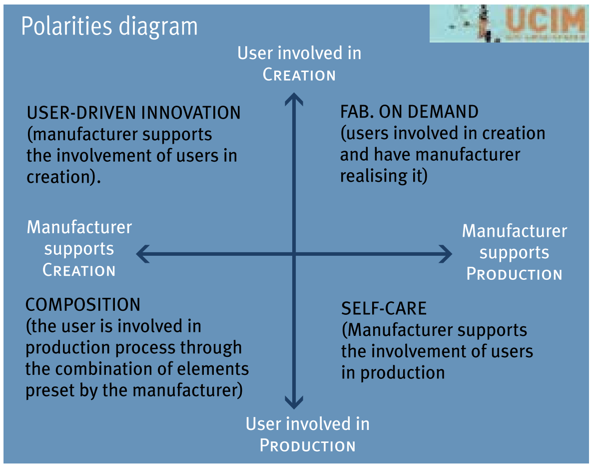


Figure 2: UCIM typology - nature of interaction

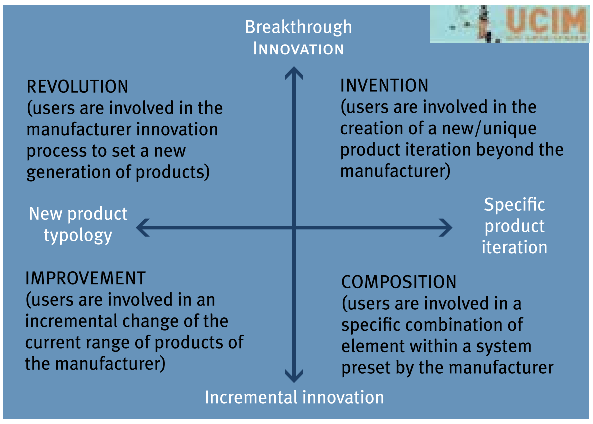


Figure 3: UCIM typology – outcome of interaction

Scenarios for User Centered Innovation

Departing from insights that were generated from the two pilot roadmaps, four general desirable UCIM scenarios were identified (figure 5). These scenarios do not only describe a high degree of user integration into innovation processes but are also incorporating a prospect for a sustainable and competitive production located in Europe.

Scenario 1: MyProductValley
This scenario comprises individualised production in local production clusters with a joint space for interaction with the customer such as a semi-virtual furniture showroom in the case of the furniture sector. For less complex products the scenario envisages networks of shops where individual data is captured and personal products are produced within nearby factories.

Scenario 2: Create and Carry
This scenario envisages shops where some product components are produced on the spot in a back-office workshop and assembled together with standard parts into personal products according to users demand. Some of the individual components can be generated through modification of existing components others completely freely.

The scenario also embraces manufacturing centres where personal products are produced on the spot on demand through fabbing on the base of 3D design information either for individual consumers or for business applications - e.g. spare part production within a technology centre.

Figure 4: Fictive advertising campaign for scenario MyProductValley in furniture industry

Scenario 3: Leasing My long-term needs
This scenario features provision of individual product service systems that are adapted to customer needs over the whole lifetime either through exchange of product or through continuous adaptation of one long lasting product.

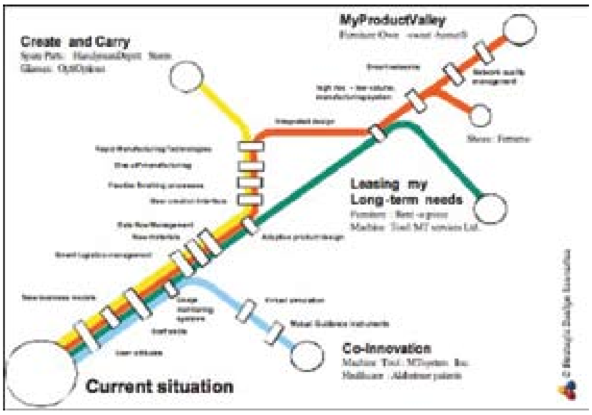


Figure 5: UCIM scenarios and roadmaps

Scenario 4: Co-Innovation
Co-Innovation involves close long-term collaboration between manufacturer and (lead) users to innovate according to users needs. The scenario will often involve joint workshops where specific methods and supportive technical equipment are used for joint generation of new products. Another important element of this scenario is proactive observation of the customer to identify user innovation and user needs and continuous uptake of the monitoring results and transfer into innovation activities.

Roadmaps towards User Centered Innovation

To realise the UCIM scenarios a number of elements from diverse realms such as technologies organisational concepts and skills need to be aligned. The UCIM roadmaps show the most important «stops» on the road towards some desirable UCIM destinations (cf. figure 5).

A customer view - The UCIM Street

The UCIM street (figure 6) gives an idea how a future world might look like where UCIM scenarios are realised in a number of sectors. It is populated by a number of places such as shops, ateliers and offices providing spaces for manufacturers and users to innovate together in different ways.

Figure 6: The UCIM Street

How to foster the roadmaps

For each of the enablers of the UCIM roadmap research and support measures needed to speed up its development were suggested. Five areas were proposed where measures could be aligned in order to foster a transition towards beneficial UCIM scenarios in European manufacturing industry.

- Manufacturing system for UCIM
- User interface for UCIM
- Adaptive product and service design
- Smart and open networked production
- User attitudes

Across these areas the following actions were recommended:

- **Real life learning for UCIM**
  Establishment of attractive UCIM pilots to raise awareness among users and create learning spaces for companies and other actors.
- **Orienting research towards UCIM**
  Integration of users and user research into publicly funded R&D projects.
- **Make the case for UCIM**
  Collection and documentation of experience with UCIM applications establishment and promotion of success stories best practice and transfer of concepts between sectors.
- **Open up knowledge for UCIM**
  Fostering of debate on IPR revisions in favour of user innovation.
- **Align actors for UCIM**
  Targeted set up of user-producer-dialogues in dedicated innovation areas through local clustering and in particular Foresight initiatives. This could be aligned to Lead market initiatives.
- **Purchasing for UCIM**
  Launching of public procurement with a view to promoting user involvement.
- **Experiment with UCIM**
  Develop tailored UCIM strategies for companies with the aid of innovation researchers taking the Danish experience as a model.
- **Find out more about UCIM**
  Launching of additional socio-economic research to explore in more detail the nature of change towards user centred innovation for various sectors, products cultural contexts as well as its social and economic impacts and the emerging requirements for innovation policy.

Sources and References

- FutMan project: http://ec.europa.eu/
- ManVis: cf. EFMN Brief No. 053 http://www.efmn.eu/
- Manufuture Platform: http://www.manufuture.org/
- Hippel, Eric von (2005): Democratizing Innovation, MIT http://web.mit.edu/evhippel/www/books.htm

Long-term Innovation Priorities for Bashkortostan

Authors:	Alexander Sokolov / sokolov@hse.ru Sergey Shashnov / shashnov@hse.ru			
Sponsors:	Ministry of Education and Science of the Russian Federation Federal Agency for Science and Education			
Type:	Regional foresight exercise			
Organizers	Foundation for Innovation Support, Ufa, the Republic of Bashkortostan; Institute for Statistical Studies and Economics of Knowledge, Higher School of Economics, Moscow			
Duration:	2005-2006	Budget: N/A	Time Horizon: 2015	Date of Brief: July 2007

Purpose

The Ministry of Education and Science of the Russian Federation started systemic foresight activities aimed at different issues related to science, technology and innovation. Following development of national S&T priorities (see [1]), it launched a study to identify priority areas for innovation development for a pilot region – the Republic of Bashkortostan. The methodologies and design of the project are to be used as a pattern for other regions, whereas the results obtained contribute to the development of the regional programme of social and economic development.

Foresight in Bashkortostan: Identification of Regional Innovation Priorities

The foresight study of innovation priorities of the Republic of Bashkortostan was conducted in 2005-2006 as a pilot project aimed at developing and testing methodologies for building long-term innovation strategies at the regional level.

The foresight exercise was implemented by the Bashkortostan Foundation for Innovation Support and the Higher School of Economics (a Moscow based university). One of the key goals of the foresight study were to develop the lists of regional critical technologies and the most promising areas of their practical application, to identify key factors to foster innovation, increase competitiveness, strengthen existing and create new networks for knowledge transfer between enterprises and academic institutions.

Natural Resources for Sustainable Economic Development

The Republic of Bashkortostan (Bashkiria) is located in the Volga region of Russia (Fig. 1). Its population exceeds 4 million, of which 2.6 million live in urban settlements (more than 1 million in the capital city of Ufa). The republic possesses significant natural resources including oil, gas, coal, iron and copper ores, gold, salt, limestone and gypsum. Together with substantial raw materials and manufacturing industries it creates a solid basis for overall sustainable economic development

Fig. 1: Republic of Bashkortostan

Recent Economic Growth

For the last few years Bashkortostan has been demonstrating significant economic growth: in 1998-2005 the GRP and the volume of industrial production have grown by more than 50%. The major contribution to this growth has been made by the oil sector and manufacturing industries.

Low Level of Innovation Activity

Despite the relatively good position of Bashkortostan compared to most of the other Russian regions, the Republic's authorities consider that substantial economic potential, rich natural and human resources per se cannot secure future well-being of the region.

The low level of innovation activity, weak linkages between industries, R&D units and universities hamper regional development. The share of innovation products and services constituted only 4% of total sales and 1% of exports in 2005. Intramural R&D expenditure in the Republic did not exceed 0.5% of GRP. Even though the limited budget funds allocated on R&D are mostly distributed on the institutional basis (with respect to size of relevant R&D units) with a very small share of funds that are subject to competition.

The technology transfer networks are underdeveloped, and industrial enterprises prefer to purchase from abroad (sometimes obsolete) turnkey technologies despite the fact that in the region there exist world-class research teams.

How to Catch Up?

One of the key goals of the Foresight study was to identify key factors to foster innovation, increase competitiveness, strengthen existing and create new networks for knowledge transfer between enterprises and academic institutions.

The general objective of the project was to develop methodologies for identification of regional innovation priorities with respect to both regional peculiarities and national interests.

Among the specific tasks there were:
- assessment of Bashkiria's S&T and innovation capacities;
- benchmarking regional S&T potential against other Russian regions and the federal level;
- identification of key factors ensuring sustainable innovation development;
- selection of regional critical technologies and the most promising areas of their practical application;
- contribution to the regional strategy for social and economic development.

Finding the Balance between Regional and National Priorities

The set of methodologies was selected with respect to best available practices [2]. It was, on the one hand, based on a general approach and envisaged expert assessment of regional S&T and innovation capacities vis-à-vis federal S&T priorities in order to identify the breakthrough fields able to provide competitive advantages both to the regional enterprises and to Russia as a whole. On the other hand, the methods were customised for the region and included SWOT analysis and detailed studies of innovation demand (from regional enterprises for new technologies) and supply (capacities of regional R&D units and universities to develop relevant technologies).

A set of regional critical technologies was developed on the basis of SWOT analysis, interviews, expert surveys and brainstorming seminars. For each area an expert panel (15 to 20 leading researchers and specialists from industrial enterprises) was created that was engaged in the project activities during the whole period of its implementation.

The project design envisaged sequential use of particular methods with the aim to provide evidence-based analysis, maximum utilisation of expert knowledge, interaction and creativity by expert participation.

The whole foresight process was designed with respect to the national priority areas for S&T and critical technologies developed by the Russian Ministry of Education and Science and approved by the President of the Russian Federation in 2006 [1]. While developing the methodology of selecting the regional innovative priorities, consistency with the approaches applied earlier at the federal level (for details see [3]) was assured.

National critical technologies and relevant lists of the most promising goods and services (to be produced on the basis of those technologies) were examined with respect to regional socio-economic needs (demand side) and S&T capacities (supply side) of the R&D institutions and universities. Each critical technology was subsequently split into a set of particular technology fields, which were analysed by expert panels. Those of them that were expected to contribute to innovation development got the highest ranks and were used as a basis for the selection of priorities.

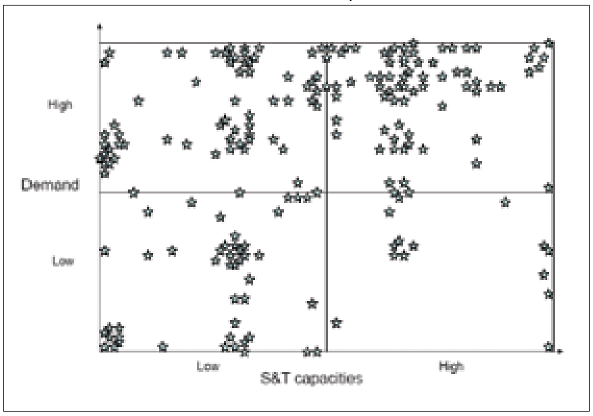


Fig. 2: National critical technologies vs. regional supply and demand

The analysis of 190 technology fields (which combined for 34 national critical technologies) has shown that most of them are either better developed and highly demanded or vice versa are underdeveloped and less demanded. It means that the regional S&T capacities are potentially well suited to meet needs of local industry and society (Fig. 2). Most of the exceptional cases (high demand and poor supply) were related to power generation technologies.

Seven Key Technology Areas

The following seven technology areas in bold letters have been chosen as the regional innovation priorities:

The work of expert panels has resulted in lists of regional critical technologies.

Information and telecommunication
Intellectual management systems
Processing, storing, transmission and protection of information
Distributed computing and systems
Production of software
Nanosystems and materials
Volume nanostructure materials
Surface nanostructure materials
Composite polymers and elastomers
Composite and ceramic materials
Membranes and catalytical systems
Living systems
Bioengineering and cell technologies
Enzymatic, bioartificial, biosynthetic and biosensor technologies
Biomedical and veterinarian technologies of life support and protection of human beings and animals
Medicines
Diagnostics, medical treatment, and preventive treatment of the diseases
Manufacturing
Mechatronics modules based equipment
Forming, thermal processing, control and assembly
Laser and plasma technologies
Energy
New and renewable sources of energy
Energy production from organic raw materials
Energy saving systems for transportation, distribution and consumption of heat and energy
Rational use of nature
Monitoring and forecasting the state of atmosphere and hydrosphere
Resource assessment and forecasting the state of lithosphere and biosphere
Processing and utilisation of technogenic wastes
Decreasing risks and damages of natural and technogenic catastrophes
Environmentally safe exploration of layers and extraction of minerals
Transport and aviation
Managing new generation transportation systems
Aviation engineering
Energy-efficient engines for transportation systems

Among the most promising societal and economic implications the experts indicated the following product groups:

ICT: software development tools, CAD/CAM/CAE for oil and gas well-drilling, power engineering and other applications, systems for data protection and distributed computing for GRID-technologies;
Nanosystems and materials: super strong, superfluid and other types of composites, nanostructural metals, implants, special instruments, fixing systems et al.;

Living systems: medicines, immune-modulators, biofertilisers, transgenic plants, biodiagnostic gadgets, biochips;

Manufacturing: equipment for processing engine components, processing high-alloy steel and metals, equipment on the basis of laser, nuclear and plasma technologies for production of materials, membranes and surfaces, gas-turbine engines for power engineering and gas-pumping;

Energy: gas turbines for electricity production, cooled perforated blades with multicomponent thermo barriers, energy saving equipment;

Rational use of nature: water preparation, supply and purification, non-invasive control systems, conservation of used oil wells, seismic profiling of oil stocks, biochemical decontamination of toxic wastes;

Aviation and transport: helicopters, engines for aviation, jet nozzles with controlled thrust vector, trolley buses.

For more detailed information see [4].

Impact of the Exercise: Promoting Key Industries

The Bashkortostan government has been developing a mid-term (up to 2015) strategy for social and economic development. The foresight project findings created a background for the strategy components related to S&T and innovation. Among the policy options considered by the regional government there are complex measures aimed at modernisation of major enterprises in key industries, designing efficient mechanisms for integration of S&T, universities and industries, introduction of new competition-based S&T programmes with participation of businesses. Relevant changes in regional legislation are planned aimed at promoting innovation activities, technological modernisation and diversification of the regional economy (transition from a predominantly fuel based economy to deeper processing of oil, gas and raw materials, increasing added value, introduction of high-tech products).

The list of regional S&T and innovation priorities will become one of the key components of the regional strategy. It will serve as a background for practical implementation of regional S&T and industrial policies. The success of the regional policies will to a large extent depend on their consistency with overall national strategies. The approach used for the foresight study allowed detailed expert analysis of what technologies the regional economy needs, which of them could be successfully developed in the Republic, and how Bashkortostan might coordinate its innovation strategies with neighbouring and other Russian regions.

A very important implication of the study was the need to build informal networks between major stakeholders in the region (the government officials, industrialists, S&T and education communities). The consensus on the key areas of innovation development achieved in the course of expert panels and other activities has created a platform for further concerted actions and for development of regional policies that are consistent not just with federal strategies, but can be agreed upon by all parties involved in their implementation.

Sources and References

- http://www.mon.gov.ru/
- UNIDO (2005). Technology Foresight Manual. Vol. 1, 2.
- Sokolov A. Russian Critical Technologies 2015. Foresight Brief No. 079. http://www.efmn.eu/
- Shashnov S. The Foresight study for the Republic of Bashkortostan. FORESIGHT. 2007, N1, p. 16-26 (in Russian).

Technology and Innovation in Flanders

Authors:	Smits Elke: elke.smits@ewi.vlaanderen.be, Thoen Vincent: vincent.thoen@ewi.vlaanderen.be, Ratinckx Elie elie.ratinckx@ewi.vlaanderen.be, Debackere Koenraad: koenraad.debackere@econ.kuleuven.be, Elisabeth Monard: elisabeth.monard@fwo.be, Danielle Raspoet: danielle.raspoet@ewi.vlaanderen.be, Vinck Karel: karel.vinck@cumerio.com
Sponsors:	Flemish Science Policy Council
Type:	Regional technology foresight exercise
Organizer:	Flemish Science Policy Council (VRWB), Elke Smits: vrwb@vlaanderen.be
Duration:	Jan. 2005 – Dec. 2006 · Budget: NA · Time Horizon: 2015 · Date of Brief: May 2007

Purpose

Knowledge and innovation are the key factors in ensuring Flanders' future prosperity and welfare. The government, companies and knowledge institutions must join forces to create focus and critical mass in strategic areas that strengthen Flanders' competitive position and offer potentially substantial social benefits. Foresight studies are an excellent means of linking science and technology with innovation in industry and society while at the same time creating a decision-supporting framework for regional innovation policy and its relationship with regional economic developments.

Regional Technology Foresight in Flanders

Flanders, the Flemish region in Belgium, has taken an important commitment to stimulate innovation as part of its Lisbon and Barcelona engagements. Innovation dynamics and their relationship with economic development have stimulated the interest of policy makers in technology foresight exercises at the national and regional level. During the past seven years, the Flemish government has supported a consistent approach to co-develop a variety of relevant case and sector studies and an accompanying methodological framework.

This four-stage methodological framework allows for identifying, exploring, monitoring and supporting the development of scientific and technology domains by defining and implementing supportive actions and instruments from the perspective of stimulating innovation within the region.

Focus on Technology and Innovation

While in the past this framework has been developed to allow policy makers to arrive at well argued choices related to science and technology policies within specific sectors and industries, the Flemish Science Policy Council has applied this methodology for delineating priorities on technology and innovation in Flanders with a view to ensuring Flanders' future prosperity and welfare.

Insights into the current situation regarding scientific research, technological development, innovation and economic activity in Flanders, and into key and relevant trends in the field of research and innovation, as analysed in international foresight studies, have made it possible to set priorities via a broad consultation process.

The following six strategic clusters were identified for Flanders:

Strategic cluster 1: Transport – Logistics – Services – Supply Chain Management

Strategic cluster 2: ICT and Services in Healthcare

Strategic cluster 3: Healthcare – Food and Agriculture – Prevention and Treatment

Strategic cluster 4: New Materials – Nanotechnology – Manufacturing Industry

Strategic cluster 5: ICT for Socio-economic Innovation

Strategic cluster 6: Energy and Environment for Services and Manufacturing Industry

The prioritisation is the result of an interactive and iterative consultation process involving 130 technical and economic experts, divided into six panels, one for each strategic cluster. Working on the basis of an international trend analysis, the expert panels selected priorities for Flanders based on a positioning and Delphi analysis. Experts were questioned about the feasibility of these trends by 2015, the technological and economic strength of Flanders with respect to these trends, leading countries for these trends, possible bottlenecks in financing, education, regulatory processes, innovation in existing firms and spin-off activity to translate the technological trend into economic activity of significant value.

The following criteria were set to establish priorities within each strategic cluster:

- Which development in technology and innovation has the greatest potential to create wealth in Flanders starting from a technological strength?
- Which development in technology and innovation has the greatest potential to create wealth in Flanders starting from an economic strength?
- Or both?

After two panel sessions, a consensus on priority techno-economic trends was reached by the expert panels for the six strategic clusters.

Across all the strategic clusters, the experts also identified and highlighted a number of focal points, not necessarily relating to a particular field. These more contextual preconditions and critical innovation factors could potentially have a major impact on Flanders' innovative strength. A questionnaire was filled in by 85 respondents across the six strategic clusters regarding these preconditions. It asked:

- How important they were for increasing Flanders' innovative strength?
- What was Flanders'current position with respect to each condition?

Techno-economic Trends and Critical Innovation Factors within the Strategic Clusters

This foresight study – a collaboration between 130 technical and economic experts from industry and knowledge institutions – identifies 30 priorities (Table 1) and 15 preconditions within six clusters of strategic importance to Flanders:

- **Strategic cluster 1: Transport – Logistics – Services – Supply Chain Management**
  Intermodal transport, intelligent supply chain management, intelligent transport systems, virtual design and production
- **Strategic cluster 2: ICT and Services in Healthcare**
  E-health with the emphasis on the electronic medical file and integration of multiple health care information systems, innovative healthcare services and products for (home) based healthcare, medical imaging and processing, multidisciplinarity: bioinformatics, chemoinformatics, neuroinformatics
- **Strategic cluster 3: Healthcare**
  Prevention- Treatment, molecular diagnostics and biomarkers, preventive and therapeutic vaccines, cell therapy, molecular biology research for targeted diagnosis and therapy, translational medicine, interdisciplinarity with applications in health care, food and agriculture, relation between food and health, agricultural biotechnology, industrial biotechnology
- **Strategic cluster 4: New Materials – Nanotechnology – Manufacturing Industry**
  Structured micro- and nanomaterials, materials for nanoelectronics, micro-optics, photonics, micro-mechanics, unique composites, materials and material systems that interact with the environment, enabling technologies
- **Strategic cluster 5: ICT for Socio-economic Innovation**
  Advanced networks: broadband-mobile-wireless, criteria of advanced networks: ambient intelligence – context awareness – security, converging technologies and application development, e-applications: e-health and e-society
- **Strategic cluster 6: Energy and Environment for Services and Manufacturing Industry**
  Efficient use of energy in industry and buildings, smart grids, power generation, sustainability of production processes and products

The outcome of the questionnaire on the preconditions for Flanders' innovative strength was unambiguous (see Figure 1): all of the preconditions could be considered as 'important', 'very important' or 'essential' for Flanders' innovative strength. Moreover, Flanders' current position with respect to different preconditions was perceived as 'insufficiently' to 'averagely' competitive. In this way, the experts identified a set of preconditions which were then systematically classified based on the questionnaire. Naturally, these preconditions can be further refined based on quantitative economic analyses to gain a more detailed insight into possible policy implications and resulting policy suggestions. However, this was not one of the aims of the present study.

ACTUAL POSITION FLANDERS				
Average competitive	Dual use	S&T communication Education R&D settings	Human capital International networking	
Low competitive		Innovation SME Labour market Labour cost researcher Fiscal matters Public procurement Bureaucracy	Regulatory process Venture capital Longterm vision on research funding	
Not important	Important	Very Important	Essential	IMPORTANCE FOR INNOVATION

Figure 1: The importance for innovation and Flanders' current position with respect to the 15 preconditions, as perceived by the six expert panels.

Responsibilities of Government and Social Partners

1. Expert-approved prioritisation of technology and innovation in Flanders

To increase Flanders' innovative strength, the Council stresses the need to pay simultaneous and coordinated attention to both priorities (trends) and critical innovation factors (preconditions). The Council emphasises the major responsibility of both the government and social partners in this respect.

2. Valorisation of the prioritisation by government, industry and knowledge institutions

The Council considers this prioritisation of technology and innovation to be a reference framework for all stakeholders in Flanders: the government, industry and knowledge institutions. Valorisation of the reference framework operates in two dimensions: intensity, ranging from active influence to guidance, and policy involvement, ranging from hands-off to hands-on (see Figure 2).

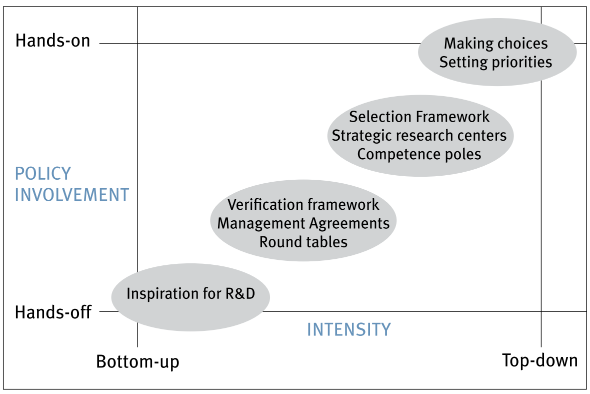


Figure 2: Valorisation of the reference framework

Role of Government

The Council proposes to use this reference framework initially as an assessment framework for existing instruments and initiatives. In recent years the Flemish government has already created a whole array of instruments covering the entire innovation chain, for which the reference framework may provide useful information:

- New applications within the policy framework for strategic research centres (SRCs) and competence poles could be assessed against this reference framework.
- The reference framework could be used when drawing up management agreements/covenants for new and existing SRCs and competence poles. In fact, the existing strategic research centres and the so-called competence poles have a clear link with the six strategic clusters.
- The expert-approved prioritisation may also be a vehicle for further implementing the Round Table concept within a strategic cluster. It will be an innovative and pioneering stimulus with added value for innovation policy in Flanders.
- The reference framework could also serve as a guide for the Flemish Innovation Policy Plan, which aims to integrate innovation-related activities into all policy areas handled by the Flemish government, such as environment, healthcare, logistics and transport.

In the Council's view, the government also has an important role to play as a catalyst in increasing Flanders' innovative strength. During the prioritisation process, the six expert panels identified the following 15 preconditions for increasing Flanders' innovative strength, known as structural innovation (see Figure 1).

Role of Industry

This expert-approved prioritisation will also be submitted to the sector federations for further implementation within their respective sectors, in line with the defined priorities. This will broaden the support base still further.

Role of Knowledge Institutions

This expert-approved prioritisation will also inspire research and development at research institutions and associations.

3. Importance of this foresight study for innovation-related activities in Flanders

A knowledge-intensive society cannot operate without regular, well-founded discussions on the developments taking place in technical and economic fields. Flanders is no exception and requires such discussion exercises on the macro level. A more systematic approach to foresight studies will create a framework for Flemish policymakers that is capable of supporting and justifying strategic policy choices on technology and innovation issues. The foresight study is a lively, dynamic process with a broad support base that dovetails nicely with European initiatives.

With this study, the Flemish Science Policy Council VRWB has succeeded in getting all of the stakeholders significantly involved in innovation-related activities and therefore in the future of Flanders. Expert panels comprising a large number of highly competent and committed experts from industry and knowledge institutions have worked together to develop a vision for the future and in so doing have reached a consensus. These experts have high hopes for the future and are willing to continue to work together on innovation-related activities in Flanders.

Sources and References

1. Debackere K., Veugelers R., Bouwen R., Van Looy B., Zimmerman E., Methodological framework for examining science and technology in Flanders, K. U. Leuven, 2000
2. Key Technologies Cluster Approach, European Commission, 2005 www.cordis.lu/foresight/kte_expert_group_2005.htm
3. Smits E., Van Looy B., Debackere K., Monard E., Five years of regional technology foresight: the Flemish experience, Veille Stratégique Scientifique et Technologique, Lille, 2006
4. Van Looy B., Debackere K., Andries P., Zimmerman E., Callaert J., Verbeek A., Technologies for the future: looking a decade ahead, Incentim K. U. Leuven, 2001

Luxembourg First National Technology Foresight

Authors:	Sylvie Rijkers-Defrasne: rijkers@vdi.de, Oliver Krauß: krauss@vdi.de, Anette Braun: braun_a@vdi.de), Axel Zweck: zweck@vdi.de, Future Technologies Division at VDI TZ Karlheinz Steinmüller : steinmueller@z-punkt.de, Z_punkt The Foresight Company Frank Glod: Frank.GLOD@fnr.lu, Carlo Duprel: Carlo.DUPREL@fnr.lu, National Research Fund, Luxembourg (FNR)			
Sponsors:	Ministry of Culture, Higher Education and Research http://www.mcesr.public.lu/			
Type:	National foresight exercise			
Organizer:	National Research Fund (www.fnr.lu), CM-International (Phase 1), VDITZ - Future Technologies Division (www.zt-consulting.de) and Z_punkt The Foresight Company (www.z-punkt.de) (Phase 2)			
Duration:	18 months	Budget: N/A	Time Horizon: 2016	Date of Brief: Aug. 2007

Purpose

In the context of the Lisbon strategy and the Barcelona targets, the Luxembourg government intends to increase the level of public spending on R&D from about € 50M in 2005 to € 220 M by 2009 and to concentrate the budget increase on a limited number of promising research areas on the basis of clearly stated strategic and operational objectives. The purpose of the first national foresight in Luxembourg, conducted in 2006-2007, was to inform policy-makers and provide direction for the definition of these national research priorities.

Luxembourg's Innovation and S&T Policy at a Turning Point

The fact that Luxembourg is a very prosperous country relying mainly on a very competitive service sector and especially on the high-performing financial sector has led, up to recent years, to a neglect of innovation policy. The innovation expenditure in Luxembourg, the country with the highest GDP per capita in Europe, is only 68% of the EU average and Luxembourg displays significant weaknesses in innovation performance – contrasting with the economic performance of the country.

Luxembourg's gross expenditure on R&D reached 1.78% of GDP in 2003 – one of the lowest ratios in the OECD area. As for industrial R&D, policy was for a long time dominated by the steel industry. A key feature of the Luxembourg research landscape today is still the important role played by the private sector which contributed to 89% of total R&D expenditure in 2003. Moreover, almost two-thirds of private expenditures are made by just a few companies such as Goodyear and Delphi, major players in the automotive component industry.

By contrast, the public research system in Luxembourg is relatively young, and in some respects, remains under-developed. The creation of new institutions, such as the University of Luxembourg in 2003 or the National Research Fund (FNR) in 1999, and new infrastructures, such as the City of Science planned for 2011, illustrates the rapid changes the research landscape is facing. Despite the high increase between 2000 and 2005, the level of public R&D expenditure is still very low and reached 0.3% of total R&D expenditure in 2005.

However, innovation policy has been at a turning point since the adoption of the first national innovation programme in 2005. In the context of the government's strong commitment to the Lisbon strategy and the Barcelona targets and in view of conditions for long-term economic growth becoming less favourable – rising unemployment, changes in the economy's sectoral structure –the following objectives were set: raising investments in R&D to 3% of GDP, strengthening innovation particularly in SMEs and fostering entrepreneurship, as well as increasing the number of graduates in science and engineering.

Furthermore, the Luxembourg government announced its intention to increase the level of public spending on R&D from about € 50 M in 2005 to € 220 M by 2009 and to concentrate the budget increase on a limited number of promising research areas on the basis of clearly stated strategic and operational objectives.

Foresight as a Tool to Inform S&T Policy

With the recognition of the role of research and innovation and of a strong national research base in contributing towards the future development of the country, the first national technology foresight was launched in the beginning of 2006 with the aim to provide part of the basis for:

- identifying national research priorities in the public sector with short-term and/or long-term socio-economic interest for Luxembourg;
- assisting the development of outstanding centres of science and technology excellence in Luxembourg;
- ensuring the specialization of public research centre (CRP) facilities into centres with a limited number of specific areas of high level expertise;
- determining appropriate investment levels through support instruments such as the FNR programmes.

The foresight was conducted as a participative process mobilising more than 300 stakeholders from industry, academia, civil society and policy-makers in workshops and interviews. In Phase I of the foresight (Jan.-Sept. 2006), the current situation of the Luxembourg research landscape was analysed (impact and success of existing public research programmes, policy instruments, public research actors, etc.), as well as international R&D trends in order to identify possible promising areas for public research. Phase II of the foresight exercise (Oct. 2006-June 2007), focused upon a set of six thematic fields (ICT; physical sciences and engineering; law, economy and finance; environmental sciences; life sciences; social sciences and humanities) with the aim of defining national priorities for research funding allowing tackling major socio-economic and environmental challenges to be faced by Luxembourg in the next 10 years.

Major Challenges to be Faced by Luxembourg in the Next 10 Years

The following challenges – to be faced by Luxembourg in the next ten years – were identified in a one-day workshop involving stakeholders from Luxembourg society, business and research at the beginning of the 2nd phase of the Foresight.

Societal changes:

- Adapting the educational system to the societal and economic needs of a multilingual and multicultural society.
- Avoiding "parallel societies" and strengthening social, economic, political and cultural participation of immigrants.
- Reforming the social security system: coping with rising unemployment, cross-border interrelations of the social systems and population ageing as well as adapting to new family models.
- Increasing the efficiency of the health care system and health promotion, as well as counteracting the increase of chronic diseases due to population ageing, "unhealthy" nutritional habits and environmental problems.

Competitiveness and Sustainable Economic Growth:

- Minimizing the economic risks associated with Luxembourg's specialization in financial services.
- Developing new "competence niches" based on expertise and efficiency as distinguished from former "sovereignty niches" based on regulatory advantages – in particular in emerging fields such as biotechnologies and services (e.g. logistics).
- Reconciling ecological and economic imperatives ("ecological issues as new business opportunities").
- Building scientific excellence, developing, attracting and retaining highly skilled domestic and foreign human resources.
- Improving the transportation and logistics infrastructure.
- Coping with high land prices and the scarcity of real estate.
- Adapting to European integration and the changing notion of national sovereignty.

Environmental Challenges:

- Reducing energy consumption, increasing energy efficiency and diversifying the energy mix.
- Facing water scarcity, promoting a sustainable water management and coping with the increasing risk of floods due to urbanisation.
- Coping with the impacts of climate change.

National Research Priorities for Luxembourg Public Research

Innovation in Services

Research related to innovation in general and innovation in services in particular is expected to contribute to consolidating and improving Luxembourg's current international competitiveness in financial and business services, on the one hand, and to support diversifying the Luxembourg economy and improving Luxembourg's innovation capacity, on the other. In particular, the following lines of research were identified:

- **Performance and Development of all Financial Systems:** with a focus on the investment fund industry and the traditional private banking activity.

- **Fostering the Economic and Legal Framework for Innovation:** determination of the right balance between European harmonisation and intergovernmental competition (esp. regarding investment fund law, contract law, company and commercial laws, but also employment protection legislation and intellectual property rights).
- **Business Service Design and Innovation:** development and improvement of new, innovative and high added-value (e-)services (business model innovation, business process efficiency – and flexibility and business service regulation compliance). Beyond business services, e-government, e-administration, e-learning and e-health applications were deemed as important.
- **Information Security and Trust Management:** contributing to consolidating Luxembourg's reputation as a safe harbour for information – esp. for the banking and broadcasting industry. Research areas like identity and risk management, privacy as well as digital rights management have top priority.
- **Telecommunications and Multimedia:** supporting the development of more convenient personalised services and improving the ICT infrastructures for the aggregation and distribution of content – including (multilingual) multimedia applications.

Sustainable Resource Management in Luxembourg

The importance of research contributing to building a sustainable society and economy in Luxembourg was highlighted – not least in order to cope with the environmental challenges to be faced by Luxembourg in the next 10 years. Moreover, given the country's size and the related opportunity to being able to implement a systematic, holistic and transdisciplinary approach to sustainability, the vision was developed to make Luxembourg a showcase for regional sustainability. In particular, the following lines of research were identified:

- **Managing Sustainable Development:** monitoring and analysis tools for the use of natural resources for e.g. the water and soil quality, air pollution, etc.; understanding of the energy and material flows in Luxembourg; implementation of ecotechnologies; integration of economic and ecological goals; consumer information models; political consulting; etc.
- **Biodiversity and Ecosystem Functions:** evaluation and monitoring of biodiversity; impacts of climate change and pollution; human-biodiversity interactions; management and conservation; economic relevance of biodiversity; etc.
- **Sustainable Management of Water Resources:** water pollution; water scarcity; flood risk; impact of climate change and of new agricultural practices; risk assessment and management; remediation of polluted ground water; etc.
- **Sustainable Uses and Sources of Energy:** increasing energy efficiency and reducing Luxembourg's economic dependencies on energy imports; increasing the share of regenerative and renewable energy sources (esp. biomass energy); energy efficient concepts for buildings; recovery and co-generation in industrial processes; etc.
- **Sustainable Agro-Systems Management:** adaptation of Luxembourg's agricultural sector to expected climate change and EU regulations; sustainable farming; water and soil protection; healthy nutrition; consumer education and behaviour; etc.
- **Spatial and Urban Development:** urbanisation; metropolisation; spatial aspects of social exclusion; transport and mobility; local and regional governance; etc.

New Functional and Intelligent Materials and Surfaces, and New Sensing Applications

Developing novel knowledge-based materials and surfaces with tailored properties and functions in various applications is seen as a field of great future importance offering a wide range of technological, scientific, and economic opportunities. It is recommended to focus on application-oriented research activities, building on intense collaboration between public and private research sectors.

Among the targets are: synthesis, analysis and processing technologies for high performance and multifunctional or intelligent materials and surfaces on the basis of polymers, semiconductors, composites, ceramics, metals and nano-structured materials. Research on new sensing applications based on new sensing effects is deemed as very promising for Luxembourg as there is a high market potential for new low-cost sensors, for instance, in the automotive sector, but also in the health, environmental and biotechnology sectors.

Biomedical Sciences

Research in biomedical sciences is expected to contribute to improving public health, quality of life, and health care delivery as well as to coping with the health challenges. Furthermore, this research priority aims to render Luxembourg research in life sciences internationally competitive and to stimulate the establishment of a biomedical industry in Luxembourg over the next 5 to 10 years. Following research issues were highlighted:

Public Health:

- **Health Information and Promotion** (esp. addressing life style diseases and mental health issues);
- **Environmental Health:** indoor and outdoor pollution; occupational health; reducing the use of antibiotics; traceability and labelling of industrial/food products; etc.

- **Assessment and improvement of the healthcare system:** quality, health economics, etc.
- **Regenerative Medicine and Tissue Engineering** for age-related diseases deemed as a promising new area of research expected to significantly improve the therapeutic arsenal of so far untreated severe diseases. Tissue engineering in combination with the development of novel materials for bio-devices is also expected to lead to new medical devices and diagnostic tools.
- **Translational research programmes** consisting of multidisciplinary teams which foster the collaboration between scientists, engineers and clinicians and hence accelerate the basic research concepts towards clinical application.

Labour Market, Educational Requirements and Social Security

Long-term research contributing to improving the match between labour supply and labour demand – especially in view of a rising unemployment rate, demographic ageing and changes in the sectoral structure of the economy – was identified as a national research priority. In particular, the following research issues were highlighted:

- **Understanding Labour Supply and Demand:** incentives for work participation; work qualifications and motivations of cross-border workers; consequences of an ageing population and a shrinking workforce; hiring behaviour of private and public organisations; etc.
- **Social System and Welfare:** labour market transitions and social security, new work and social protection models, gender issues, impact of cross-border and immigrant workforce on the economy, etc.
- **Educational / Qualification Issues:** determinants of educational achievement/failure, individual learning paths, transition from education system to labour market, life-long learning, effectiveness of educational system, etc.

Identities, Diversity and Integration

Research on identity, ethnic, cultural, and language diversity and integration addresses characteristics which distinguish Luxembourg from its neighbours making it a test bed of European integration – and of social studies. The following research issues are expected to contribute to understanding the dynamics of change of the Luxembourg society:

- Luxembourg history(ies), language(s) and culture(s);
- role of education and language in identity building;
- family and individual identities in a multicultural society;
- migration and social cohesion;
- intergenerational relations;
- Federative Multilingualism;
- education;
- political participation and representation;
- etc.

Technology Platforms

The following specific technology platforms, allowing for the cost-efficient and expert use of expensive equipment and infrastructure, were highlighted in the foresight as necessary conditions for leveraging research in several domains:

- **Modelling and Simulation:** high performance scientific computing and powerful computation infrastructure for material sciences, environmental sciences (e.g. modelling in climate change and resource management) and life sciences (e.g. bioinformatics).
- **Central Information Infrastructure** acquiring and managing scientific information (scientific literature, publication licences, searchable databases) housed at the National Library; digitisation and meta-data association.
- **Biobanks and esp. Tissue Bank** for supporting biomedical research, systematically collecting samples of human tissue, cells or body fluids based on state-of-the-art protocols for collecting, conditioning and storing biological material, and guaranteeing its traceability through association of anonymous donor data.
- **Proteomics, Genomics, Bioinformatics, etc.**

New Public Research Programmes Expected in 2008

The FNR Foresight exercise contributed to promoting a – new – foresight culture in Luxembourg. The six national research priorities identified serve as a basis for FNR recommendations to the Ministry of Culture, Higher Education and Research concerning the selection of national research priorities. They should lead to new public research programmes to be launched at the beginning of 2008. However, in order to be able to implement these research priorities, further structural challenges – regarding, for instance, the absorption capacity of the Luxembourg research system, the legal framework for research, etc. – need to be addressed in the near future. Moreover, although the foresight provides the general directions for the next ten years, it is expected that these priorities will still need to be revisited during the course of the next decade in order to ensure alignment with unforeseen trends.

Sources and References

FNR Foresight Final Report, National Priorities for Public Research and Other Findings (2007), www.fnrforesight.lu

Potential for Biomimetics in Austria

Authors:	Christina Raab / christina.raab@gmail.com Michael Nentwich / mnent@oeaw.ac.at			
Sponsors:	Austrian Federal Ministry of Transport, Innovation and Technology			
Type:	Single issue national foresight exercise			
Organizer:	Institute of Technology Assessment (ITA) of the Austrian Academy of Sciences Strohgasse 45, 5; A-1030 Vienna, Austria			
Duration:	June-August 2006	Budget: N/A	Time Horizon: 2010	Date of Brief: May 2007

Purpose

The field of biomimetics (biomimicry, bionics) has in recent years gained scientific acceptance and standing, and has become an innovative research area at academic institutions and in industry worldwide. Many promising solutions for challenging complexity and future-oriented technologies with a wide range of applications have been inspired by nature. This study aimed to investigate the current status and level of activities in the field of biomimetics in Austria and to identify its potential for the future nationwide.

The Emerging International Biomimetics Scene

Biomimetics is an interdisciplinary field of knowledge at the crossing point of biology and technology, which seeks to apply certain principles from biological systems to technological strategies. Biological structures, functions or forms of organization are used as analogies or abstractions and serve as models, idea concepts or inspiration for innovative breakthroughs in complex scientific, engineering and market problems.
The range of potential uses of biomimicry is enormous, and the fields of applications span architecture and design, surface and materials technologies as well as sensors, robotics, medical engineering and management.

Recent Developments

The roots of transferring knowledge from nature to synthetic constructs date back to the 16th century (Leonardo da Vinci), but it has only been in the past few decades with the development of new and improved research methods (such as nanotechnology) that biomimetics has become established and may soon be recognized as a scientific discipline. Support for research and development in academia and industry on biomimicry subjects has greatly increased in recent years, so that the number of international publications, conferences, exhibitions, educational TV productions and spin-offs has also shown a steady gain. Some biologically inspired concepts have in fact already been turned into commercially available products. Classic applications for biomimicry are the Lotus effect in self-cleaning surface coatings, Velcro, coatings of artificial shark or dolphin skins on airplanes or ships, the bionics car by Mercedes Benz or winter tire treads inspired by cats of prey. The vast pool of ideas derived from nature has the potential for many new future highlights particularly with respect to sustainability, energy efficiency and green solutions.

International Initiatives

Research in biomimetics is conducted worldwide, though strongly centred in the USA, with a focus on materials and military applications, and in Japan foremost in the fields of robotics and locomotion. Notable biomimicry activities in Europe can be identified in France in the field of robotics, in Switzerland in the direction of management and cybernetics, and in Great Britain, with the formation of the Biomimetics Network for Industrial Sustainability (BIONIS). Germany has taken a leading role in Europe with the formation of research networks, clustering of competencies, extensive collaborations, academic courses and most notably the foundation of an elaborate Bionics Competence Network (BIOKON) and the joint foundation of the International Bionics Center.

Analysis of Biomimicry Situation in Austria

In view of the rapid expansion of the international biomimetics scene as well as the highly promising outlook of biomimicry based approaches to innovation, knowledge transfer, cross-disciplinary education and new product and market developments, it was now essential for Austria to assess the current status of and to identify the potential for biomimetics in the country. This brief study was commissioned by the

Austrian Federal Ministry of Transport, Innovation and Technology and is based on research of Internet sources and on interviews with experts from universities, research centres, management companies and industry. No thematic restrictions were imposed for the scope of this work, and all the manifold areas of biomimicry and resulting activities in Austria were investigated.

Biomimetic Activities in Austria

The findings of this study demonstrate that biomimetics based approaches are used for complex problem solving and innovative applications at some universities, non-academic research institutions as well as certain companies. These activities are currently located primarily in Vienna, Upper Austria and Styria. They are, however, widely scattered and based on local initiatives with little or no exchange of ideas and results between the respective groups. As a result, there is no unified picture of the Austrian biomimetics community, as much of the focus of Austrian researchers in this field is directed abroad, including a brain drain of Austrian scientists.

Competencies ... not Only for Product Innovation and Design

Mature competencies for biomimetics in Austria are available in diverse fields of research and application. Several research institutions and consulting companies use bionic and cybernetic concepts as creative methods for innovation and product development. They further aim to encourage biomimetics approaches in small and medium-size companies for innovative and improved products. Strong competencies using biomimicry also exist in architecture and industrial design, focusing on construction systems, space architecture and eco-design, and are complemented by special educational programs, academic research, industrial and international collaborations. Very well developed activities for biomimetics can be found in materials and surface engineering at a multitude of academic institutions, independent research centres and companies. Competencies in these areas include biomaterials, structural modelling, lightweight compounds and new materials with improved mechanical and tribological properties and stability inspired by biological materials. Research and development in materials is furthermore enhanced by lectures and educational courses on biomimicry. The fields of sensors, robotics, medical engineering and biomechatronics also exhibit substantial proficiency.

Austrian Biomimetics Competence Network Founded

Awareness and acceptance of the benefits of looking to nature for solutions has gradually developed within the past ten years along with a gradual increase of activities at least within a small group of movers. Efforts have been made within these circles to further education on the vast potential source of ideas provided by nature, to integrate aspects of biomimicry in educational programs and to support specialization of studies along with graduate theses in this field. Some initial scientific collaborative projects were arranged within Austria, but these remained mostly of temporary nature and were limited by a lack of support and funding.

Starting in the year 2000, several **exhibitions** in museums, research parks and at technology fairs have been devoted to subjects of biomimicry and occasional lectures have been organized, mostly held by foreign guest speakers. Television programs on future technologies have also broadcast short reports on discoveries and innovations from biomimetics.

Increasing numbers of attempts have been made the last few years by **consulting companies** to try and inform small- and medium-sized businesses of the potential of biomimetics for innovation and market position. Several awareness events have been organized with specific targets of industrial communities and business to improve the accessibility and transparency of biomimicry as a technique of fostering creativity.

An increased openness towards biomimicry has consequently been observed in Austria in recent years, but large numbers of people, especially those outside research and **educational institutions** are still not aware of the variety of ideas found in nature and their possible applications.

In the summer of 2006, the Austrian Federal Ministry of Transport, Innovation and Technology commissioned the present study with the aim to identify biomimetics activities nationwide, to evaluate future potential in this field and to provide a basis for decisions on possible **funding initiatives**.

The initiation and execution of this study had the effect of tying the isolated biomimetics groups closer together, contributed to their visibility and, most importantly, provided an incentive to realize the formation of a nationwide network that had only been thought about before. Subsequently, an Austrian bionics competence network was indeed founded in the spring of 2007 with regular meetings and the participation of experts in the field nationwide.

A web platform is about to be established with the goal of informing, concentrating and fostering communication, to exchange ideas and to facilitate cooperative projects. Finally, the opening of a bionics park in Styria is planned for the fall of 2007, which will be dedicated to all areas of biomimetics, from education and research to applications in business and industry. The current protagonists of activities in biomimetics also envisage networking and collaborations on the level of the European Union and the organization of national, application-oriented biomimicry meetings and conferences in Austria.

Expecting Inputs for Sustainability, Nanotechnology, Biocybernetics

A large number of ideas, suggestions and concepts for a research network as well as strategies to increase the visibility of biomimicry in Austria were put forth by the persons interviewed for the report. However, neither industry nor government has provided support or financial means for such initiatives to date (May 2007). The report concludes that significant potential and competencies for biomimetics exist in Austria. The current view suggests that these will provide important contributions in the fields of creativity techniques, architecture and design, surfaces, materials, robotics and sensor technology as well as biomechatronics and medical technology. Because of the nature of this future growth industry, new breakthroughs in applications and solutions can also be expected in the near future in the areas of sustainability, nanotechnology and biocybernetics.

Policy Initiatives

Based on the findings of this study and the recognition of the strong potential for biomimicry in Austria, the Austrian Federal Ministry of Transport, Innovation and Technology plans to install financial incentives to be in place by the end of 2007. These initiatives may take the form of support for the formation of networks or calls for funding of research proposals, announcements of competitions or prizes for innovation.

As far as future policy making in the field of biomimicry is concerned, it is strongly advised to avoid short-lived hype or marketing gimmicks associated with this area and instead to fund activities with a well defined long-term perspective which involve participants from all levels by means of integrated common projects. It is of crucial importance to note that biomimicry is an interdisciplinary, innovative field of knowledge and that for this reason the manner in which projects are categorized, evaluated and selected for funding may well have to be adapted accordingly. Innovation, the transfer of knowledge and the development of products resulting from Austrian work in biomimicry may well benefit from policies that focus on applications and partnerships between research institutions and industrial companies.

Raising Public Awareness

Above all, this study demonstrates that there is an urgent need to inform and educate the relevant communities and the public in general. Educational establishments are a crucial starting point for teaching and raising awareness of the manifold opportunities offered by biomimicry and to promote cross-disciplinary thinking. The planned theme park in Styria, the web community as well as additional measures as the marketing of current books on the subject and placement of television programmes are most likely to successfully raise public awareness.

International Collaboration

The establishment of and support for a nationwide Austrian network seems ever more important as a strong international biomimetics community is currently emerging. This applies equally strongly to the need to build collaborations and exchange programmes with international partners.

Sources and References

ITA report of September 2006, online available at: **http://epub.oeaw.ac.at/ita/ita-projektberichte/d2-2e18.pdf**

Corporate Foresight in Small and Medium-Sized Enterprises

Authors:	Kai Jannek / jannek@z-punkt.de Klaus Burmeister / burmeister@z-punkt.de
Sponsors:	Supported by the Federal Ministry of Education and Research (BMBF) within the framework of Innovation and Technology Analyses (ITA), Z_punkt GmbH
Type:	National expert survey
Organizer:	Z_punkt GmbH The Foresight Company, Klaus Burmeister, info@z-punkt.de
Duration:	2007-2008 · Budget: NA · Time Horizon: NA · Date of Brief: June 2007

Purpose

The objective of this research project is to identify the foresight requirements of German small and medium-sized enterprises (SMEs), their corporate foresight activities, to the extent that they exist, and limiting factors for systematic foresight approaches. To this end, an expert survey was conducted with SME decision-makers. Its purpose is to make executives more aware of the indispensability and the potential foresight offers in changing markets and business environments, and supporting them in their foresight approaches.

SMEs – A White Spot in Corporate Foresight Research

So far, empirical corporate foresight research has focused solely on large-scale corporations in the respective European countries, and in Europe as a whole. The foresight needs and activities of SMEs, in contrast, have stayed below the radar, even though the value of SMEs' contribution to employment, value creation, and innovation is well recognized.

This research project aims to analyse the market situation and business environment of SMEs and, in doing so, assess their foresight needs. Furthermore, there is the question whether and in what way SMEs explore possible future market and environmental developments and utilize the resulting knowledge.

Z_punkt GmbH prepared and mailed a questionnaire (in digital and paper form) to SME executives. To permit comparability, the survey gives closed questions using a five-point Likert scale (1=strongly agree, 5=strongly disagree) for most queries concerning foresight needs, and a three-point Likert scale (1=regularly, 2=sometimes, 3=never) for most questions about foresight activities. Closed questions are always followed by open questions to elicit additional information.

Survey Participants and their Market Environments

1,000 German companies were invited to take part in the survey; 115 of which responded (11.5%). Based on annual sales volume, the participants can be classified as

- traditional SMEs (< 50 mio. €: 38%),
- upscale SMEs (50 mio. – 1,000 mio. €: 49%), and
- corporate-like SMEs (> 1,000 mio. €: 13%).

17% of participants have fewer than 100 employees, 29% have between 100 and 250, 20% have between 250 and 1,000 employees, and 34% employ more than 1,000 people.

Market Environments

The participants come from a wide range of industries, most prominently machine building (10%), construction (9%), automotive and logistics (9%), marketing and media (9%), food (8%), retail (8%), IT and software (8%).

Asked for their main regional markets, almost all participating SMEs (95%) operate in Western Europe. Some also cover North America (15%) and Eastern Europe (13%). China and Japan, on the other hand, currently only play a very minor role (3% and 2%, respectively).

SMEs' Foresight Needs

It is assumed that the foresight needs of an SME can be derived from several indicators. Accordingly, survey participants were asked to assess their market and business environment dynamics, and their companies' development plans.

Regional Expansion: Eastern Europe Major Point of Interest

The more a company is willing to change, the more it depends on foresight knowledge to provide security for investment decisions. The pressure to act is mainly the result of intense competition in terms of price (1.8 on average on the five-point Likert scale) and quality (2.2), but also innovation and time (2.6 and 2.7, respectively). Many SMEs seek to escape heightened competition by focusing on regional expansion and product innovation.

47% of all survey participants are mainly interested in expanding their business to Eastern Europe. China (32%), Western Europe (25%), North America (23%) and Japan (15%) are also future target markets.

Incremental Improvements Dominate

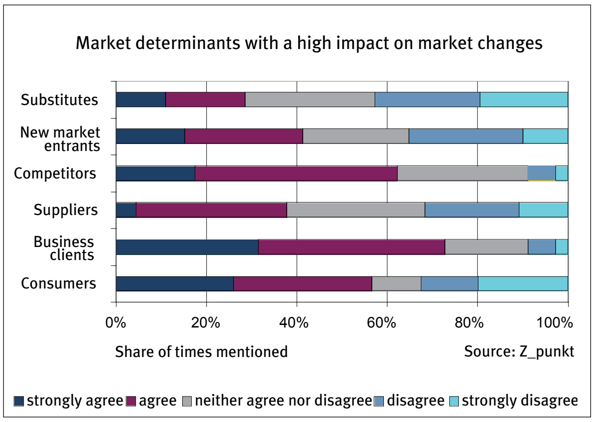
With regard to innovation activities, incremental improvements dominate (87%), but fully new products and services have also been developed in recent years (64%). Furthermore, new production processes (46%) and new business models (35%) have been pursued. Only 2% of the participating SMEs have not innovated at all.

Short Lead Times

However, development lead times for new products remain short, with 28% of all SMEs surveyed having a short (0-1 year), 44% a medium (1-3 years), and 10% a long time horizon (over 3 years). 18% have no standardized development times. Therefore, market research might suffice to satisfy contextual knowledge needs given that the relevant markets and business environments remain relatively stable within planning cycles.

Market Perception: Increasingly Dynamic

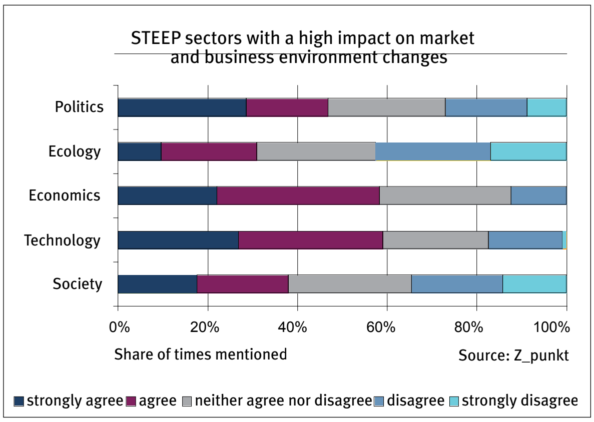
However, SME executives perceive their markets as increasingly dynamic. They consider their markets to have changed strongly in the last three to five years (2.0) and further significant changes are expected for the next three to five years (1.9). This would make foresight more useful to SMEs' future plans than short-sighted market research. The monitoring focus would have to be on the future development of high-impact market determinants, i.e. business clients (2.1) and competitors (2.3). SME executives consider consumers, new market entrants, suppliers and substitutes (2.7, 2.9, 3.0, 3.2, respectively) to be of lesser importance.



Changing Business Environments

It is assumed that market dynamics are, to a certain degree, the product of environmental changes. Hence, the latter have to be closely examined to project future market developments as far as possible. SME executives also see an increase in the dynamics of their business environments. These have changed strongly over the last three to five years (2.2) and further shifts are expected for the next three to five years (2.0). Here, technology, economics (2.3 each) and politics (2.6) are key environmental sectors, while society and ecology (2.9 and 3.2) are not perceived to be crucial.

Foresight Needed in Dynamic Markets and Environments



SME executives prepare for regional expansion and innovation activities. Their planning cycles are rather short. However, since SMEs operate in highly competitive and dynamic markets, it is assumed that their foresight requirements are substantial. From their point of view, the most important fields for environmental scanning and monitoring are technology, economics and politics.

Within their relevant markets, SMEs have to focus primarily on exploring possible actors' strategies. However, there is reason to challenge the SMEs' ratings to a certain extent. Given that many SMEs have business clients, but that end consumers complete every value chain, consumers as an important market determinant and society as an essential environment determinant may be underrated.

SMEs' Foresight Activities

In part, SMEs respond to their foresight demands with more or less pronounced foresight activities.

Foresight Systematics and Methods Applied

85% of the SMEs regularly monitor developments in their markets and industries (sometimes: 14%, never: 1%). Furthermore, 29% frequently scan markets and industries they are not competing in for new developments (sometimes: 61%, never: 10%). 74% of the SMEs surveyed regularly monitor issues, trends and new technologies considered relevant for their business (sometimes: 26%, never: 0%); additionally, 30% often scan their environments for new issues, trends and technologies whose relevance cannot yet be assessed (sometimes: 60%, never: 10%).

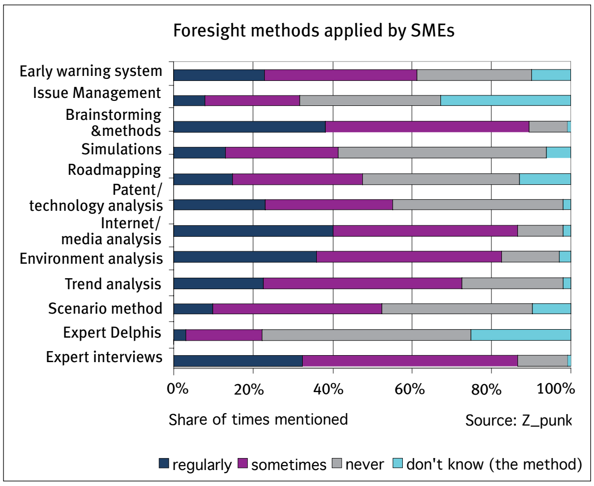
Various foresight methods for scanning and monitoring, analysis and idea transfer are used. Most frequently applied are:

- brainstorming (regularly: 38%, sometimes: 51%),
- desk research, e.g. internet and media analysis, (regularly: 40%, sometimes: 47%), and
- expert interviews (regularly: 32%, sometimes: 54%).

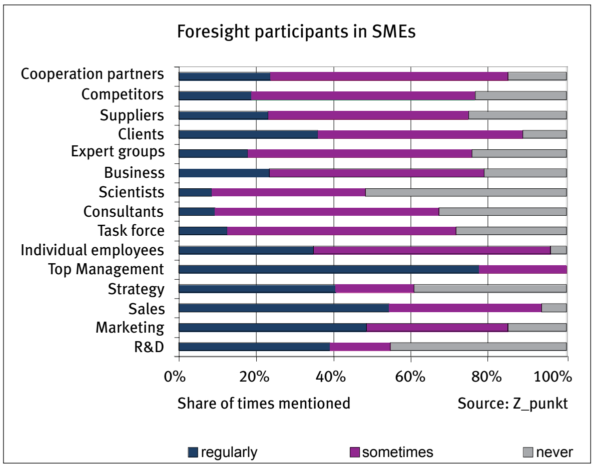
These methods are not only used most often but also considered the most important ones. In contrast, more complex foresight methods, for instance expert Delphi surveys (regularly: 3%, sometimes: 19%) and the scenario-method (regularly: 10%, sometimes: 43%) are less relevant and in some cases even unknown.

Foresight Participants and Foresight Purpose

Foresight processes in SMEs are carried out by top management (regularly: 77%, sometimes: 23%) and individual employees (regularly: 35%, sometimes: 61%). In many cases, the sales department (regularly: 54%, sometimes: 39%) and individual clients (regularly: 36%, sometimes: 53%) are also involved.



In contrast, external scientists (regularly: 8%, sometimes: 40%) and specialized departments such as R&D (regularly: 39%, sometimes: 16%) or strategy (regularly: 40%, sometimes: 20%) are rarely involved. The latter fact may be explained by the size of the companies surveyed.



Foresight is mainly used for strategic planning (1.7 on the five-point Likert scale mentioned above) and to identify new innovation fields (2.0). Foresight information is also considered useful for product improvements (2.2) and new business models (2.3), investment decisions, risk management (2.4 each) and early warning (2.6).

Foresight Impediments

In general, SME executives are aware of their companies' foresight requirements. At the very least, they disagree (4.2) with the statement that there was no need for their company to monitor market and business environment changes. However, budget and manpower capacity constraints (3.2 and 3.3, respectively) place limits on systematic foresight approaches. Furthermore, problems may occur when foresight knowledge has to be transformed into practical knowledge and ideas for new products and strategies (3.4). In the main, SME executives do not consider a lack of know-how, methodological competence, and cooperation to be impediments to foresight (3.6 each).

Basic Corporate Foresight in SMEs

Corporate foresight understood as a future intelligence gathering process is quite systematically conducted in SMEs. While the methods may be rather simple they are capably applied. Top management and individual employees are responsible for foresight processes, but sales departments and clients are also involved. This reflects the fact that the aim of foresight is mainly to support strategic planning and product innovation. However, this transfer as well as budget and manpower constraints are also bottlenecks for the implementation of a more complex foresight approach.

Rethinking SMEs' Foresight Needs and Activities

Firstly, the research project has revealed that SMEs have substantial foresight needs. This is not so much a result of long-term planning cycles, but due to high market and business environment dynamics and actors' shifting strategies. Secondly, the survey has shown that SMEs use basic but systematic foresight activities to support strategic planning and innovation management. These foresight requirements and approaches may have been underestimated so far in the business world, in the foresight community and among policy-makers.

More Appropriate Techniques Needed

SME executives have to broaden their foresight horizons and draw on more elaborate foresight methods better suited to their needs. For the highly dynamic markets and business environments they operate in, trend analysis, roadmapping and scenarios to explore alternative futures are more appropriate. Additionally, simulation techniques may be useful in SME business contexts strongly driven by third parties (e.g. clients, competitors, politics). Foresight training courses in these more elaborate methods are also essential. In addition, Corporate Foresight is one option to extend the scope of SMEs. Even though most SMEs are B2B suppliers, end consumers and social changes may have a considerable impact on their business. SME managers should therefore revaluate the importance of this sphere.

Move Foresight to Strategy Unit

The fact that in most companies, responsibility for foresight activities rests with SME top managers is remarkable. Generally, this commitment is identified as a critical success factor for corporate foresight. However, limited time resources may make the top managements' high level of involvement a drawback. Executives might be well advised to shift foresight processes to a task force, strategy unit or to consultants.

Greater Results Orientation

However, the foresight restrictions outlined above may limit the usefulness of these recommendations. Therefore, the foresight community would do well to realize the specific requirements of SMEs and the constraints they are confronted with. The question is whether foresight tools and processes can be downsized or adapted to the needs of SMEs. Foresight approaches need to be simplified and become more results-oriented. Efforts in this direction might also be welcomed by other public and corporate foresight users or clients. SMEs could be seen as test cases for a new generation of more pragmatic foresight concepts to emerge in the long run.

In the short run, cooperation and political support can be used to improve SMEs' foresight activities. SMEs do not need tailor-made future environmental scenarios. External sources can provide regional scenarios with a time horizon of five to ten years. Companies would then adapt these to their specific industries. SMEs could also cooperate in foresight networks to generate economies of scale. External experts and scientists can be temporarily integrated as desired. Finally, political decision-makers have to encourage these initiatives.

Outlook: Identify Best Practice Models of SME Foresights

The survey results outlined are only a first step in the exploration of SMEs' foresight needs and activities. For a deeper understanding, we will, in a second stage, analyse the survey results with regard to segments of comparable foresight needs. Thirdly, within each segment, we want to identify SMEs with best practice Corporate Foresight activities. These foresight approaches will be examined in detailed case studies to serve as role models for other SMEs with similar foresight needs (from the same segment).

Sources and References

- Burmeister, Klaus; Neef, Andreas; Beyers, Bert: Corporate Foresight. Unternehmen gestalten Zukunft. Hamburg 2004
- Duin, Patrick A. van der: Qualitative Futures Research for Innovation. Delft 2006
- Müller, Adrian: Strategic Foresight in Companies. An international survey on trends and futures research processes. Unpublished paper 2006. Results to be published soon, see http://www.strategicforesight.ch
- Neef, Andreas; Daheim, Cornelia: Corporate Foresight – The European Experience. In: Wagner, Cynthia G. (ed.): Foresight, Innovation, and Strategy – Toward a Wiser Future. World Future Society 2005, p. 223-241
- Project website (German): **http://www.openforesight.de**

Creative System Disruption: Towards a Research Strategy Beyond Lisbon

Authors:	Jennifer Cassingena Harper, Rapporteur, High Level Expert Group Key Technologies / Jennifer.harper@mcst.org.mt			
Sponsors:	European Commission Directorate-General Research			
Type:	EU-appointed High Level Group			
Organizer:	European Commission Directorate-General Research, Unit K2 and EU High Level Group			
Duration:	Dec.2004 - Sept. 2005	Budget: € 200 000	Time Horizon: varying by subject	Date of Brief: April 2007

The Mandate: Key Technologies Critical for Europe's Future

Europe is currently facing the challenge of a highly dynamic and fluid policy context. It is confronted with a seemingly accelerating pace of change, both internally and externally. Internally, a culturally diverse, ageing and risk-averse population, a mix of high tech and declining industries and growing environmental and security concerns require governments to design new frameworks for research and innovation. Externally, this policy context is influenced by and influences the emergence of key technologies. The speed and the magnitude of their disruptive impact on the economy and society in turn depend on and are embedded in a wide range of socio-cultural factors.

This challenge calls for a substantial leap forward in thinking and mindsets, by moving from incrementally improving on business-as-usual approaches to exploring new paradigms and alternative futures. A redefinition of the "European model" is called for, capturing the minds and spirits, and bringing together the inherent collective strengths of the EU and its 27 member states. It should comprise a combination of strategic responses addressing short to medium and long-term research policy agendas. For this purpose, a Key Technologies High Level Group composed of experts in 15 key technology areas, and led by a chairperson and a rapporteur, was set up by the K2 Unit of Directorate-General Research, to "assess the potential and the emerging scientific and technological research topics in fifteen specific areas, their impact on EU competitiveness and societal fabric, and the potential response of EU and its Member States".[1]

Building on Technology Reports

At the kick-off meeting in January 2005, the Group started by deliberating and agreeing on the main objectives of the exercise and the methods and approaches to be used. It was agreed to build as extensively as possible on previous work, in particular recent reports by the High Level Groups on Converging Technologies and Universities.

In this first phase, the work of the Group concentrated on the preparation of area reports by the experts in the following research and technology fields: agriculture, biotechnology, cognitive sciences, communications, complexity, energy, environment, health care, information technology, Manufacturing, nanotechnology, security, services, social sciences and the humanities (SS&H) and transport. The reports were to assess where the EU stands in the particular field on the global scale as well as to provide a forward look. Beyond area-specific analysis, the reports also highlight cross-linkages and interfaces

with other research and technology areas. By way of examples or cases the main trends and key messages (e.g. technology roadmaps) were illustrated. In order to facilitate cross-referencing and comparison, the reports were organised according to a common template, covering the following main points:

- Key socio-economic challenges Europe is facing in relation to the research/technology field
- An overview of EU policy responses in the last 5-10 years
- An overall comparison of Europe's position in research in the field (based on levels of R&D spending for the EU as a whole, member states and competitors/partners and current level of related research funding under FP6)
- A SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) of research and innovation in Europe's

sectors and industries
- Policies and programmes of Member States and international organisations
- A Forward Look: long-term challenges and visions in the respective fields, drawing on recent foresight work

At the start of the subsequent second phase, the draft area reports were presented and discussed at an internal group workshop. Emerging issues and headlines were elaborated, cross-linkages with other reports identified, and "executive" SWOT-statements as well as first policy recommendations discussed. The consolidated area reports were then subject to a validation process in the course of which another 10-15 experts in the field were consulted. Building on a condensed SWOT analysis and the key messages from the individual key technology reports, the compilation of the Synthesis Report was led by the Chair and rapporteur. The cross-cutting issues or common clusters of messages and lessons to learn were finally cross-checked with the area experts.

The Group's key findings and recommendations were presented at the EU Conference on Key Technologies in September 2005 inaugurated by Commissioner Potocnik. The visions and reactions of leading personalities from the public and private sectors complemented the presentations of the individual reports and were fed into the final synthesis report.

Policy Transition and Coordination

The EU R&D Action Plan represents a joint agenda for research and innovation actors at European and member state levels to realize creative systemic disruption. As part of that agenda, government policy needs to undergo an equally significant transition as the respective research and innovation systems. For instance, defining the right frameworks and incentives is crucial in order to enable a long-term change or transition to sustainable production-consumption systems, relying on what has been called system innovations. Ground-laying research on system innovations and transitions is the key to give better orientation to policy and corporate decision-making (Weber 2005).
The policy transition and coordination theme is common to a number of the reports and relevant actions are outlined below:
- To overcome major systemic barriers and path-dependencies through organizational change.
- To promote policies which master the whole innovation chain (basic, applied research, innovation and diffusion) and address innovation policy and management in a holistic, knowledge-driven and participative way.
- To work towards more rigorous policy coordination of strategies, methods and approaches, i.e. the coherence of policy initiatives taken in different realms, ranging from research and technological development (RTD) policy and regulation, standardization, assessment and market creation to competition policy and infrastructure development. Coordinated policy strategies are particularly important for system innovations in order to create stable long-term perspectives for innovating firms. As a consequence, a better coordination between policies is now increasingly sought, departing from a focus on individual instruments towards well-tuned strategies to embed adaptive combinations of instruments (Rennings et al. 2003, Weber 2005).
- To encourage more intense policy coordination across different instruments and funding mechanisms, ranging from research to innovation, technology transfer and commercialization and to ensure that the synergetic effects between different policy instruments are exploited in order to promote key technologies effectively (Weber 2005).

Foresight as a Catalyst for Creative System Disruption

A number of the reports highlight foresight's crucial role in facilitating the policy transition process and preparing the ground for system disruption. Foresight is instrumental in:

- providing a new arena/space "where policy and investment decisions are discussed and in which «futures» are contested..." (Braun 2005) and helps quantify and qualify the future potential of a key technology;
- playing an outreach role in bringing about broader stakeholder participation, engagement and learning in the communication of longer term issues and the building of consensus on the most promising areas;
- acting as a coordination device of collective strategy development for realizing system innovations in society, by aligning "the individual strategies of the variety of industrial, research, policy and societal actors... when they are geared towards long-term objectives that cannot easily be achieved through market mechanisms"(Weber 2005);
- providing insights into decisions related to strategic funding of research and development in relation to emerging opportunities and niche areas;
- overcoming two pervasive weaknesses: the reluctance to approach the problems within a systemic and holistic framework and a resistance to adopting disruptive strategies;
- reflecting on EU research strategies – long term and short term – in the light of global pressures;
- evaluating the strategic fit between the Lisbon Strategy, the long term and short term research agendas with ever changing external parameters.

Sources and References

[1] This Brief draws on the Synthesis Report prepared with Professor Teresa Lemos, Chairwoman of the Group, and the individual reports of the HLG experts.

Braun, A. (2005): Healthcare: Key Technologies for Europe, a report from the expert group 'Key technologies for the future', ftp://ftp.cordis.europa.eu/pub/foresight/docs/kte_healthcare.pdf.

EC (2005): Creative system disruption towards a research strategy beyond Lisbon, a report from the expert group 'Key technologies for the future' (EUR 26968).

EC (2004): FACING THE CHALLENGE. The Lisbon strategy for growth and employment, Report from the High Level Group chaired by Kok, W., November 2004, http://europa.eu.int/growthandjobs/pdf/kok_report_en.pdf.

EC (2004): A forward look at Europe's strengths and weaknesses in key research domains", Research Directorate General, Working Paper, Draft 23.12.2004.

Kavassalis, P. (2005): Key Technologies For Europe: Communications, August 2005, a report from the expert group 'Key technologies for the future' ftp://ftp.cordis.europa.eu/pub/foresight/docs/kte_communications2.pdf.

Lemos, T. & Harper, J. (2005): Creative system disruption towards a research strategy beyond Lisbon, a report from the expert group 'Key technologies for the future' (EUR 26968).

Rennings, K., Kemp, R., Bartolomeo, M., Hemmelskamp, J., Hitchens, D. (2003): Blueprints for an Integration of Science, Technology and Environmental Policy (BLUEPRINT), Final Report of the EU financed project BLUEPRINT, November 2003.

Weber, M. (2005): Environmental technologies, Background Paper for the European Commission's High Level Group on 'Key Technologies', July 2005, ftp://ftp.cordis.europa.eu/pub/foresight/docs/kte_environmental.pdf.

All Key Technologies Reports can be downloaded from http://cordis.europa.eu/foresight/kte_expert_group_2005.htm.

Public Service 2022 in Ireland

Authors:	Mark Callanan, mcallanan@ipa.ie			
Sponsors:	Institute of Public Administration			
Type:	National Foresight Exercise			
Organizer:	Institute of Public Administration, info@ipa.ie			
Duration:	2005-07	Budget: NA	Time Horizon: 15 years	Date of Brief: June 2007

Purpose

By 2022, Ireland will be celebrating 100 years of self-government. The Public Service 2022 project was launched to consider what kind of Ireland could exist by then, and what kind of public service might emerge. The idea behind the project was to identify and examine trends and drivers of change both for Ireland and for the public services over the coming years. It was intended to present some of the options and choices which exist in improving the capacity of the public service to help design, respond to and implement policies that are determined by government.

Public Service in Critical Condition

The impetus for the project came from a group of senior public servants who felt that the public service in Ireland was losing its capacity to critically analyse the implications of long-term trends. Ireland has undergone rapid demographic, social, economic and technological change in the past 15-20 years, and to some extent, government has been playing 'catch-up' in terms of coping with some of the changes that have taken place.

Major new challenges and opportunities are expected to emerge for the public service in the coming years in a range of areas, including those posed by technological developments.

New Challenges Posed to the Public Sector

Drawing on analysis of possible or likely developments in Irish society, as well as international developments over the next fifteen years or so, the project objectives involved:

- Drawing up a range of scenarios that would challenge the public sector.
- Analysing the state of readiness of the public sector to meet the different challenges within these scenarios.
- Assisting the public sector to identify changes that are needed to meet emerging challenges.
- Assisting the public sector in exploring new arrangements – including organisational arrangements across the whole public sector – for service delivery.

Ultimately, the project was designed to stimulate creative and imaginative thinking, and to develop the capacity of public servants in considering long-term trends and policy analysis.

Quantitative and Qualitative Approaches to Identify Core Drivers

The project sought to identify a number of 'core drivers' affecting change in Ireland and abroad, both from existing material and data, but also from a wide range of actors through an extensive participatory approach. There are very few examples of such a foresight project being developed focusing specifically on the public services. It was decided that the best approach in this context would be the preparation of scenarios involving a large number of stakeholders.

The project sought to identify a number of 'core drivers' affecting change in Ireland and abroad, both from existing material and data, but also from a wide range of actors through an extensive participatory approach. There are very few examples of such a foresight project being developed focusing specifically on the public services. It was decided that the best approach in this context would be the preparation of scenarios involving a large number of stakeholders.

Scenario Workshops

A series of fifteen workshops, some involving over 200 people, were held in early 2006. Each group was asked to 'think aloud' in identifying and discussing different trends and their likely impact on the public service. Each workshop contained a mix of individuals, which included senior, middle and junior level personnel drawn from central government, state agencies, local authorities, healthcare, the police force, primary, secondary and third-level education, private sector companies, and voluntary sector organizations.

The next step was to examine the key uncertainties within the trends identified. This was done through a survey questionnaire where respondents were asked to identify trends that could evolve in numerous different ways and that would be liable to have the greatest impact on the future. Respondents were asked to rank the trends according to their level of 'uncertainty' and level of 'impact' – those trends that scored the highest on these two dimensions were then regarded as 'critical uncertainties'.

Face to Face with the Uncertainties

The results of the questionnaire were then used at a specially convened workshop to create four outline scenarios. The scenarios were constructed on the basis of the 'critical uncertainties' as they pose the highest level of uncertainty in terms of how they might pan out. These uncertainties served as the foundations or building blocks from which the scenarios were eventually fleshed out. The initial scenario outlines were drafted and redrafted in the light of the existing data by threading together a number of 'core drivers' and trends to ensure each scenario was internally consistent. The draft scenarios were screened by a number of actors, including some of those attending the workshops.

Economic Forecasting

As part of the project, an economic forecasting exercise was also undertaken to examine economic trends, possible government revenue projections, and future demands in key areas of public expenditure, such as healthcare, education and social provision in the light of demographic projections.

Commentators for Additional Advice

As part of the follow-up and process of analysis, a number of commentators (both outside and inside the public service) then took this research to highlight implications for the public service, identifying what preparations need to be made to meet emerging challenges and seize emerging opportunities.

Role of Project Advisory Board

The project was overseen by a Project Advisory Board, consisting of a number of high-level representatives drawn from political life, the public services, the social partners (business, trade unions, etc.), and academia.

Public Service to Cope With Immigration, Economic Growth and Environmental Sustainability

A key finding of the project was that there is a 'window of opportunity' for Ireland to prepare for demographic change (such as the 'agequake'), which will not hit Ireland until 2030s, far later than most EU countries.

Other socio-economic trends identified include: immigration (a relatively new phenomenon in Ireland); changing lifestyles and societal values; individualism; globalisation, competitiveness and economic growth; energy supply; and management of environmental resources. All of these will affect the way public services are delivered, and different eventualities in each of these areas are tracked, including their impact on the public services, in different scenarios.

Emerging Technologies and ICT

Some of the technological trends identified as being of importance to the public sector include:

- Emerging growth industries such as biotechnology, nanotechnology, as well as new developments in these fields;
- Developments in information and communication technologies;
- Advances in biotechnology and healthier lifestyles leading to life expectancy of well beyond 100 not long after 2022.

Government Might Face more Single Issues and Sensationalist Media Coverage

Some of the opportunities and challenges that might arise from some of the technological changes referred to above include:

- The need to target the development of certain growth industries such as biotechnology, nanotechnology in terms of economic development agencies and third and fourth level education.
- Developments in fields such as biotechnology and nanotechnology, as well as decentralised energy generation (based on nanobio and nanomaterial approaches) may allow for reduced energy consumption and a reduced impact on the environment in certain areas.
- Developments in ICTs will lead to an increasingly complicated media environment, with fewer people reading newspapers or watching domestic television. Government is thus faced with an increasingly fragmented media, where increased competition between sources of information has led to a temptation to sensationalise.

- With ICT developments also making communication ever more easy and cheap, there could be an explosion in the number of single-issue pressure groups, usually focussed on campaigning on very specific or localised issues.
- Technology will be both an 'enabler' and a challenge in dealing with the ageing population, and in terms of the healthcare system generally. Technologies already exist to allow independent living for the elderly, and many new technologies will be developed in the healthcare sector. However the cost of some of these may be prohibitive, and society will need to start a debate on whether the considerable cost of some technologies or pharmaceuticals will really be worth the sometimes marginal impact they can have.

Generally, technology will be an important engine (though not the only engine) of productivity in the public sector – it will be necessary to maximise the potential of new technologies in this regard given the expectation that citizens will continue to demand that government does more but with less taxation revenue.

How Can Public Service Keep Addressing Certain Norms?

Key issues raised that are of relevance for policymaking include challenging and addressing certain norms that are strongly held within the public service. This will require a fundamental rethink in a number of areas. Some of the key issues raised in this respect are:

- That central decision-making, while necessary in many areas such as macroeconomic decisions, is poorly equipped to handle other challenges for the future, particularly in a more diverse society and as people come to expect customised services tailored to the needs of individuals or particular localities.
- That every problem does not require its own agency to address it as public tasks become more multi-faceted.
- That public servants must become more relevant as a means of supporting policy-development.
- That politicians cannot be responsible for everything in a more complicated world.

Empowering Public Services

Some of the choices and options open to policy-makers in making the public service better equipped to handle future challenges include:

- Empowering the 'front-line' – more responsibility needs to be given to those providing services, as they are best equipped to know what works and what will not work.
- Bringing greater accountability to public servants for both successes and failures.
- Ensuring real experience in service delivery is fed into the policy-making system.

All of the above will require fundamental changes in practice and in culture, building on existing reforms to date.

Finding the Balance between Public Service and Private Sector

As noted above, critical factors include continuing economic growth, changes in societal values, demographic change, environmental developments, and technological change. In addition to these of course, a critical factor will be political decisions regarding the balance between services that are provided through the state, and services that can be provided through the private or non-profit sectors.

Key actors therefore include both politicians and public servants. If politicians do not drive future reforms, they are unlikely to have far-reaching effects. A key set of relationships is likely to further evolve, and this will also affect change into the future. This includes:

- the relationship between politician and citizen,
- the relationship between politician and public servant,
- the relationship between public servant and citizen.

In addition to citizens, politicians, and public servants, the media will be important players in shaping trends into the future.

Sources and References

Project Website – **www.publicservice2022.ie**

The Project website contains further details on the project, including the scenarios themselves, as well as a number of working papers looking at: past critical junctures, survey data and international benchmarks of public perceptions of public services, and future drivers of change for the 'Ireland of the Future'.

A publication containing all papers and analysis for the project, including the above as well as the economic forecast and analysis and commentary on the trends and identifying preparations that need to be made for the future, will be published in November 2007

Agricultural Futures in England and Wales and Implications for the Environment

Authors:	Morris, J., Audsley, E., Wright, I.A., McLeod, J., Pearn, K., Angus, A. and Rickard, S.			
Sponsors:	UK Government Department of the Environment, Food and Rural Affairs			
Type:	National foresight exercise, agriculture and environment.			
Organizer:	Cranfield University, Bedford, MK43 OAL , UK. contact - j.morris@cranfield.ac.uk			
Duration:	2.5 years	Budget: € 250 k	Time Horizon: 2002-2050	Date of Brief: July 2007

Purpose

Agriculture in the UK and Europe as a whole is facing an uncertain future as the factors that have shaped it over the last 50 years are realigned in the face of changing priorities. In this context, this study explored possible future scenarios for agriculture in England and Wales through to 2050 in order to identify implications for the environment and possible policy interventions and research priorities to help promote sustainable agriculture.

Agriculture: Driving Factors are Realigned

Agriculture in the UK and Europe as a whole is experiencing unprecedented change as the drivers which have hitherto shaped the characteristics of the farming sector are realigned. How these factors, such as government policy, technology and international trade, will change in future is difficult to predict. Scanning the long term horizon for agriculture is useful if it can help us prepare for, and indeed influence, possible futures. A number of future scenarios for agriculture in England and Wales were explored[1] in order to identify features that might be of concern and actions that might be taken now to make the future, however it turns out, better than it otherwise might be.

How to Promote Sustainable Agriculture?

The specific objectives were to identify and explain:

(a) possible long term futures for agriculture in England and Wales,
(b) the implications of these outcomes for the environment,
(c) policy interventions and research priorities to help promote sustainable agriculture.

In the process, a further objective was to develop a conceptual framework in which possible agricultural futures could be explored.

From Historical Analysis to Simulation Models of the Future

Figure 1 summarises the research method.
A review of trends over the last 50 years identified the main drivers, processes, outcomes and consequences of changes in agriculture in England and Wales. Drawing on this understanding, scenarios were constructed to span the range of possible alternative agricultural futures. The framework used by the UK Foresight Programme[2] was applied for this purpose, distinguishing futures in terms of social values and governance.

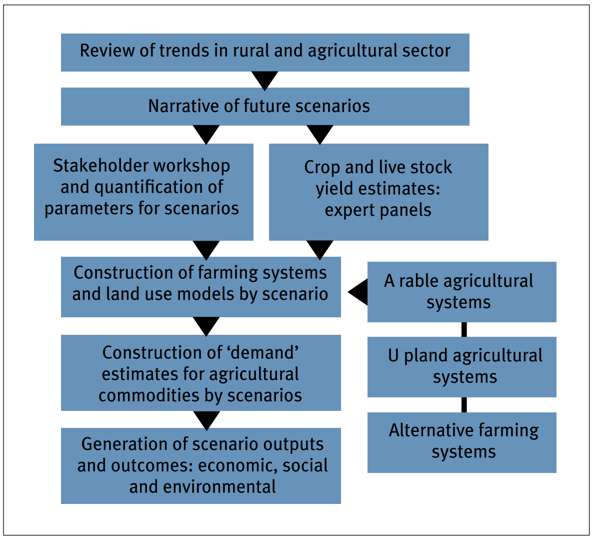


Figure 1: Research Methodology

These two dimensions produce four quadrants (Figure 2), each of which is a distinct scenario, namely: World Markets (WM), Global Sustainability (GS), National Enterprise (NE) and Local Stewardship (LS). A fifth scenario, Business as Usual (BAU), assumed a continuation of the trends apparent in 2002. Beginning with 2002 as the 'current' base year, the study set out to map these possible futures through to 2050.

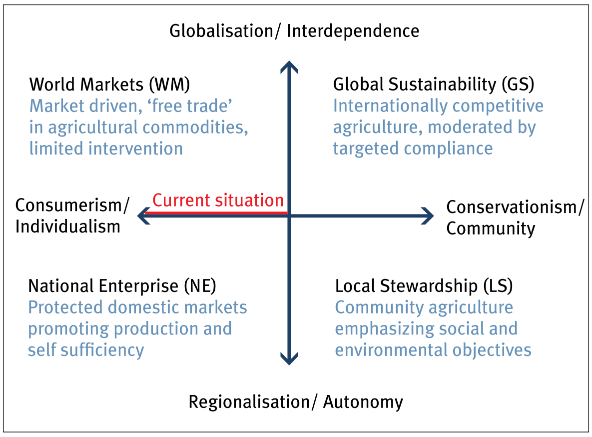


Figure 2: Agricultural Scenarios

A workshop, attended by 27 participants from major stakeholder groups, was held to derive values for indicators to represent the main differences amongst the scenarios, such as commodity prices, agricultural subsidies, farmer motivation and crop yields.

Estimates of long term future yields for crops and livestock were obtained in collaboration with researchers on a parallel project (Prediction of Yields into the 21st Century)[3].

The demand for agricultural commodities in England and Wales was estimated for each of the future scenarios through to 2050 according to assumptions regarding economic growth, population growth, consumer spending on food, changes in consumer preferences, production of bio-fuels and net import and exports of agricultural commodities. The impact of crop by-products on animal feed requirements was also considered. As a result, the proportion of total domestic consumption supplied by producers in England and Wales was estimated.

Drawing on narratives and quantitative indicators, computer based models of farming systems were constructed: one model focused on relatively intensive crop and livestock systems for lowland farming, and another on extensive, mainly upland grassland. Estimates of regional land use required to produce the crop and livestock commodities referred to above were derived for each scenario through to 2050, as well as commodity prices (which balanced commodity demand and supply), farm incomes, employment and selected environment outcomes. Each scenario was then judged against current perceptions of sustainability to identify aspects of futures which might give rise to concern.

Results of Scenario Analysis

Separate estimates, subsequently aggregated, were derived for intensively farmed lowland areas and extensive grassland in mainly upland areas.

Lowland Intensive Farming

Table 1 shows the variation in selected indicator values for lowland farming for each scenario.

Agricultural Productivity – what makes it high or low?
Total agricultural production is highest for NE which promotes self-sufficiency through intensive farming. Prices and incomes obtained by farmers (and by implication prices for consumers) are highest where production is constrained to protect the environment, notably under GS and LS. Commodity prices are lowest under BAU, WM and NE, in the latter case probably calling for direct income support from Government, as was the case in the UK prior to accession to the EU.

How much land needs to be used?
Figure 3 shows the estimated proportion of land available for lowland agriculture occupied by relatively intensive farming under each scenario. Variations in land use amongst scenarios arise due to differences in future yields per hectare and in the total demand for home-grown agricultural commodities. Land required for intensive farming declines as a percentage of current land use under WM, BAU and NE (all with energy crops). However, there is insufficient land to meet the demand for agricultural commodities including energy crops under GS and LS. Exclusion of energy crops reduces areas of intensive land use but there appears to be a shortage of land under the LS scenario.

Table 1: Relative Values of Selected Indicators by Scenario, 2050 (including energy crops)

	Weighted prodn	Weighted price	Nitrate leaching	B´grass herbicide	Soil erosion	N fertiliser	P fertiliser	K fertiliser	Water	Profit	Labour	Energy
Curr	100	100	100	100	100	100	100	100	100	100	100	100
WM	106	69	139	79	60	112	105	106	60	51	52	89
GS	134	183	135	126	92	126	119	116	85	124	90	107
NE	140	90	205	100	78	152	148	150	118	74	93	119
LS	109	248	108	102	98	104	106	108	138	130	109	99
BAU	118	60	138	81	96	110	111	108	70	63	71	95

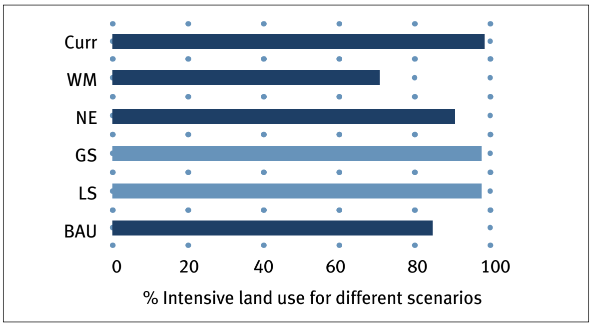


Figure 3: Lowland Land Use in England and Wales by Scenario, 2050

What about the environmental footprint?

The environmental 'footprint' of market driven scenarios such as WM and NE is moderated by the release of land from intensive farming which can be used for other purposes, such as extensive farming, nature conservation and forestry. However, where environmental requirements constrain yield potential, as with LS, there is pressure on land resources, and, in the absence of imports, food supply deficits could arise. Scenarios with 'surplus' land could support further extension of bio-fuel, but this is likely to increase pressure on marginal land.

Use of alternative technologies

An analysis of alternative technologies, namely, integrated crop management, alternative mechanisation, reduced tillage and genetically modified crops, showed that these methods can enhance profitability but vary in terms of environmental burden.

Extensive Grassland Farming

The disadvantaged uplands

Areas of land not suited to intensive arable and livestock farming because of conditions of soils, topography, altitude and related factors were treated as suitable for extensive grassland. Although they include some lowland areas, they mainly comprise areas designated as 'uplands' that are relatively disadvantaged. They are assumed to meet that part of the demand for domestic beef and sheep which cannot be met by land in the intensive lowland sector.

Effect of changes in stocking rates

Table 2 shows the estimated stocking rates in the uplands by region. Increased productivity results in reduced average upland stocking rates under most scenarios, particularly under WM, providing opportunity for restoration of natural vegetation and environmental gain. Under LS, however, a shortage of capacity in the lowlands increases pressure on the uplands, a theoretical doubling of upland stocking rates.

	Current (head/ha)	BAU	WM	GS	NE	LS	Current (head/ha)	BAU	WM	GS	NE	LS
	Beef						Sheep					
North East	0.64	140	56	61	110	253	3.5	78	70	102	172	128
North West	1.01	116	44	61	73	253	5.55	65	55	102	114	128
Yorks & Humber	0.92	128	51	61	103	253	5.05	72	64	102	160	128
East Midlands	0.77	114	61	63	76	261	4.21	64	77	105	119	132
West Midlands	1.45	130	53	61	73	253	7.92	73	66	102	114	128
Eastern	0.79	101	37	61	73	253	4.3	56	47	102	114	128
South East	0.65	101	37	61	73	253	3.54	56	47	102	114	128
South West	0.83	101	37	61	73	253	4.52	56	47	102	114	128
Wales	0.77	116	40	63	80	253	4.2	65	50	105	124	128

Table 2: Upland Stocking Rates (head/ha) of Beef Cattle and Sheep (expressed as index of current stocking) by Scenario, 2050

The effect of changes in stocking rates on upland vegetation and habitat was modelled. On this basis, WM and GS offer potential environmental gain compared to BAU, whereas LS reduces environmental quality due to increased stocking.

Employment scenarios

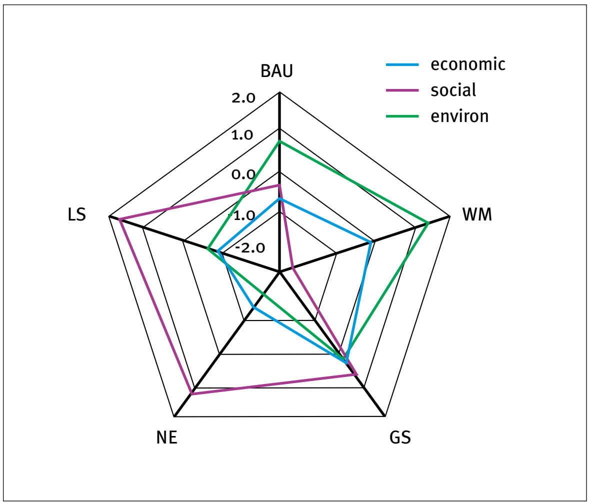
Labour employment in the uplands is affected in similar proportions to that of stocking rates, with large decreases under WM.

Sustainability Appraisal

The quantitative results of the analysis were used to assess the performance of alternative futures in terms of economic, social and environmental criteria (and related indicators) that reflect current views of sustainability, namely:

- **economic criteria** – income, value added, food security, subsidy dependence, food prices and production;
- **social criteria** – employment, support for rural, family farms and uplands, and social use of land;
- **environmental criteria** – use of fertiliser, pesticides, water, leaching, erosion and energy use, bioenergy production, biodiversity and upland pressure.

Figure 4 summarises the results of sustainability appraisal. For the assumptions made, overall economic performance does not vary greatly amongst scenarios. However, there is considerable variation in social performance due to differences in farm employment and incomes, especially in upland areas. There is also variation in environmental performance amongst scenarios. Those that release land from agriculture offer some aggregate environmental advantage, but burdens are likely to be high in intensively farmed areas. The LS scenario, though reducing the intensity of environmental effects, requires a much expanded farmed area, with increased pressure on marginal areas, including uplands.



Scores based on model outcomes, weighted by relative policy importance

Scenario	Economic	Social	Environ-mental	Aggregated with equal weight
BAU	-0.6	-0.2	0.8	0.0
WM	-0.1	-1.8	1.2	-0.2
GS	0.3	0.7	0.2	0.4
NE	-0.6	1.1	-1.1	-0.2
LS	-0.7	1.6	-0.4	0.2

Figure 4: Sustainability Appraisal of Future Agricultural Scenarios for England Wales, 2050

Farming Communities Endangered by Climate Change and Politics

Different agricultural futures appear to present common challenges for policy makers, namely: how to balance the various economic, social and environmental objectives under each scenario; how to reduce the environmental pressures of market oriented scenarios, and; how to improve the economic performance of environmentally benign ones. Given the strategic importance of food security and preventing the irreversible loss of natural assets, there is a need under all scenarios to reduce the potential vulnerability of rural areas and farming communities, including that associated with impacts of changes in global climatic and political conditions.

From a research perspective the study confirms the need for a better understanding of:

- the influence of policy, markets, technology and environmental (including climatic) change on rural land use and agricultural practices;
- the effect of land use, farming systems, technology, and farmer behaviour on the state of the rural environment and the various services it provides;
- the potential role of science, technology and farmer knowledge to enhance sustainability of farming;
- the economic and social consequences of possible futures that justify intervention.

The analysis confirms the need to continuously review the main purposes to be served by the farming sector, including food security, bioenergy, biodiversity and environmental services, livelihoods and public health. It confirms that policies are needed to integrate these multiple objectives, consistent with social preferences and styles of governance. Scenario analysis can inform strategic decisions made now by government and corporate organizations on issues such as technology development that are likely to prove beneficial under a range of possible futures.

This research has progressed the analysis of scenarios from descriptive narratives through to quantitative assessment. There is considerable scope to refine scenarios to capture the complex relationships between farming and the environment which operate on different spatial and temporal scales. Scenario analysis has the potential to support ongoing dialogue amongst key stakeholder groups, including farmers, food processors, regulators, policy makers, conservation managers and consumers, as they pursue individual and joint interests in sustainable futures.

Sources and References

- Morris, J. et al. (2005) Agricultural Futures and Implications for the Environment. Main Report, Technical Report and Supporting Appendices. Defra Research Project IS0209. Bedford: Cranfield University. Available at http://www.cranfield.ac.uk/sas/staff/publications/agfutures%20tech%20report%20final%20v2.pdf
- OST (2002) UK Foresight Futures 2020: Revised Scenarios and Guidance. London: Office of Science and Technology, Department for Trade and Industry.
- Sylvester-Bradley, R. and Wiseman, J. (eds.) (2005). Yields of Farmed Species, Constraints and Opportunities in the 21st Century. Nottingham: Nottingham University Press, UK. 651 pp.

Future Fuel Technology for APEC Regions

Authors:	Nares Damrongchai / nares@tmc.nstda.or.th Mayuree Vathanakuljarus / mayuree@tmc.nstda.or.th			
Sponsors:	Asia-Pacific Economic Cooperation (APEC) and many other co-organizers			
Type:	Regional Foresight Project			
Organizer:	The Government of Canada, Bureau of Energy and Industrial Science and Technology Research Institute (ITRI), Chinese Taipei, National Metal and Materials Technology Center (MTEC), Thailand, APEC Center for Technology Foresight (APEC CTF), Technology Management Center, National Science and Technology Development Agency, Ministry of Science and Technology, Thailand			
Duration:	2004-2005	Budget: US $ 500 000	Time Horizon: 2030	Date of Brief: June 2007

Purpose

The main aspiration was to gain strategic intelligence on future fuel technologies going beyond the current status and trends of present day energy technology and to draw roadmaps of selected future fuel technologies leading to robust plans for the future of technologies in the APEC region up to 2030. Moreover, the co-organizers of the project also anticipated continuous activities referred to as "post foresight" within APEC economies and among fuel technologies experts both during and after the project.

Asia-Pacific to Become Largest Consumer of Energy

The share of world energy use by the Asia-Pacific region is increasing, and projection from current trends indicates that by 2010 the area will be the world's largest consumer of energy. While much of this can be supplied from indigenous resources, an increasing proportion will need to be imported, particularly oil from the Middle East. The instability of this region poses threats to future supply. The vulnerability of a number of APEC economies is clear, and several economies are already completely dependent on imported oil while others will move to a dependent position by 2020.

Against this background, the project was initiated on recommendation of the 'APEC Center for Technology Foresight'`s International Advisory Board and of MTEC, a national R&D centre of Thailand. Encouragement and collaboration came from APEC Industrial Science and Technology Working Group, the Government of Canada, and in the course of the project additional participants from the Bureau of Energy and ITRI, Chinese Taipei, became active players. At the early stage, the APEC Energy Working Group (EWG) was also approached by APEC CTF to seek further research collaboration as the energy topic involved both working groups. The APEC Science Ministers' official meetings at Christchurch, New Zealand and Port Douglas, Australia in 2004 infused the activities with heightened enthusiasm; EWG group members agreed to participate in the study where experts shared technical information and have taken active roles in the project's workshops. This proved to be a unique cooperative exercise between the Industrial Science and Technology Working Group (ISTWG) and EWG to provide strategic intelligence on future fuel technologies for the APEC region.

Finding Pathways to Future Fuel Technologies in the APEC Region

This project aims to assess potential use of fuel technologies for the future in the APEC region through co-creation of technology roadmaps, involving stakeholders from business, academia and government across the APEC community. The roadmaps would include pathways for future fuel technologies to reach achievable technology targets and commercial success. It was hoped that by shaping thinking and fostering interaction, the process will eventually help institutions in planning for the future.

Workshops from Vancouver to Taipei

A pair of foresight methods were used; scenario writing and technology roadmapping (TRM). The scenario workshop was arranged in December 2004, in Krabi, Thailand. The main purpose was to create scenarios of futures of emerging energy and to use the results of the scenarios to influence and design technology roadmaps. Then technology roadmapping was employed to enable the identification of critical steps in the development of fuel technologies. There were two consecutive TRM workshops: the first workshop was hosted by Industry Canada in April 2005, in Vancouver, Canada; and the second one was organized by the Bureau of Energy and Industrial Technology Research Institute, Chinese Taipei in August 2005, in Ping-Tung, Chinese Taipei.

The project selected and grouped future fuel technologies into three different areas, i.e. hydrogen/fuel cells, conventional/unconventional hydrocarbons, and biofuels. Participants of the TRM workshops were divided accordingly into three groups for brainstorming on the selected fuel technologies roadmaps.

At the end of the project, a symposium was organized and hosted by MTEC and CTF in Chiangmai, Thailand. The objective was to wrap up what had been discussed and to summarize final key findings of the project in the light of future fuel technologies. The symposium also provided opportunities for audiences and all stakeholders to participate by commenting on the issues and creating further networks for post-foresight activities.

Stakeholder involvement from 17 countries

A total of 309 participants from seventeen APEC Economies participated in the project. Both experts of technologies and non-experts participated in the scenario workshop. About sixty experts and specialists were involved in each of the scenario TRM workshops. Seeking involvement of experts was normally handled by the network of APEC Industrial Science and Technology Working Group (ISTWG) and the Energy Working Group (EWG). Another important channel was APEC CTF's website where all information, announcements, and the latest news were regularly posted, updated and circulated among all participants during the project.

Identifying the Uncertainties

During scenario creation, key drivers of development for future fuel technologies were identified using STEEP classification – social, technological, economic, environmental and political. The results are summarized in table 1:

Social: Environmental and health concerns Urbanization and rural income disparity Knowledge-based society with increased awareness
Economic: Rising cost of fossil fuels, particularly oil Need to increase employment
Political: Energy security Interdependence of energy supplies across regions Enforcement of an agreed protocol on emissions
Technological: Integrated approach combining various technologies Low carbon economy with large reduction of carbon dioxide emissions
Environmental: Global climate change concerns Local pollution of air and water

Table 1: Key drivers for future fuel technologies

Then major uncertainties affecting development of future fuel technologies were identified and used in the breakout group discussion to create scenarios of the energy situation for APEC in 2030. These include:

- Impacts of dramatic climate change e.g. collapse of Antarctic ice sheet, changes in ocean currents, shift of demand patterns for energy over wide regions.
- Dwindling supply of oil and gas leads to bitter conflicts between major powers for control of current sources.
- Regional groupings emerge for energy cooperation to secure supplies and develop common technologies, e.g., biofuels.
- Accidents occur in development of new nuclear or hydrogen power plants.
- Public becomes intolerant of R&D on new fuels because of failure to deliver benefits.
- Technological breakthrough occurs, e.g. cheap solar, stable fusion, low temperature fuel cells.
- Leadership in alternative energy technologies by China and India alters energy choices of other counties.
- Terrorism leads to destruction of major power supply and distribution systems.
- Governments in developing countries give priority to rural energy systems.

Designing Broad Approaches for Energy Futures

The roadmaps then clarified the possible development pathways of each fuel area, mentioned in the Methodology/Approach section, and merged issues related to the interaction of these into an integrated energy pattern. The roadmaps and energy supply are vital for maximum use of investment in fuel extraction, production and distribution infrastructure to meet the needs for overall energy security, wealth of public health, and sustainable development. Distinction of fuels for two different types of applications were considered for future developments. First, transport applications, such as vehicles, require on-board supplies of readily stored, high energy density fuels, preferably liquids and gases. Second, stationary applications, primarily for electricity production and heat for commercial, industrial and residential applications, can be satisfied by a variety of input energy sources including solids, liquids and gases. This development of stationary application provides opportunities for a broader approach to energy futures (Figure 1).

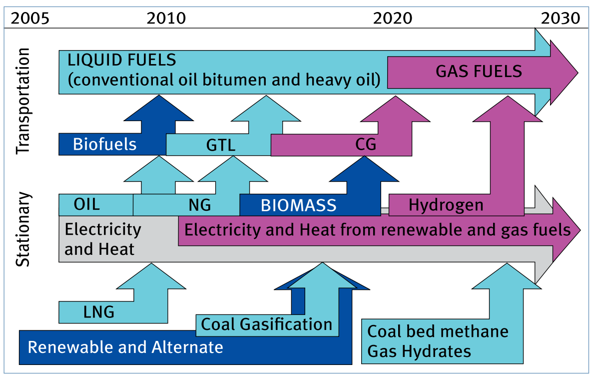


Figure 1: possible integraton of future fuel technologies

Three Major Drivers

The study emphasised three key drivers as underlined by the diagram above, i.e. 1) need for diversity of energy sources for security of supply; 2) creation of a low carbon economy to reduce greenhouse gas emissions to mitigate climate change and its impacts; and 3) improvement of urban air quality for public health.

Security of Supply

The first concerned long term risks of heightened political instability in many areas rich in liquid and gaseous fuels and the vulnerability to natural disasters of others. Within the time frame of this project, oil will remain a significant fuel particularly for transport and a move to alternate fuels is imperative for those economies that depend on imported oil.

Reduction of Emissions

The second is vital given the increasing evidence of major changes in the Earth's climate such as the rapid melting of glaciers and the increased frequency of severe storms. The move to a low carbon economy can be achieved with both fuels for stationary applications and for transport. Hydrocarbon gas fuels have lower carbon content than liquid or solid hydrocarbons and their increased use, together with CO_2 sequestration, will lead to a reduction in carbon dioxide emissions in the stationary sector. For transport the use of biofuels either as blends or neat is a move to a low carbon economy provided that engine technology is adapted for such fuels.

Improvement of Air Quality

Third, air pollution in Asian megacities stems from badly maintained vehicles and domestic use of solid fuels. Strict legislation on emissions and its enforcement, together with potential improvements on engine efficiency in new vehicles can probably solve this problem. However, growing societal pressure for change supported by political will and significant investment could lead in the long-term to a transition to a hydrogen economy through hybrid petrol-electric vehicles to fuel cell vehicles using hydrogen from a variety of sources. Vehicle manufacturers are already well advanced in the development and production of hydrogen.

Further Exchange and Technology Research Needed

Despite discussions and recommendations from the quarters of APEC economic experts, there is no one solution to the future fuel needs of the APEC region. To ensure energy security, an integrated approach is needed in which various energy technologies can make significant contributions. The roadmapping exercises of this project have developed technology roadmaps for three fuel areas and how they can be used in an integrated approach.

The emphasis on research and development of energy technologies will vary from one economy to another, depending on their resources and R&D capabilities. There is a clear need for cooperation and exchanges of research information and personnel in materials and energy R&D within APEC.

Policymakers need to be conscious of community attitudes to new energy technologies and ensure adequate steps are taken by their governments to communicate with the general public on issues of health and safety, and environmental impacts associated with such technologies, e.g. biofuels, hydrogen and nuclear power.

Even though the study has focused on three fuel areas, it is clear that development and application of other energy technologies, e.g. photovoltaic arrays, wind turbines and advanced nuclear power systems are important components of an integrated energy approach.

Sources and References

- Nares Damrongchai and Greg Tegart, Future Fuel Technology Scenario and Roadmapping for Asia-Pacific, The Second International Seville Seminar on Future-Oriented Technology Analysis, Spain, 28-29 September 2006.
- Greg Tegart and Nares Damrongchai, Future Fuel Technology, Summary Report of an APEC-wide Foresight Study, APEC Center for Technology Foresight, Bangkok, March 2006, ISBN: 974-229-864-5.
- David E. Minns, Future Fuel for the APEC Region - APEC 2030 Integrated Fuel Technology Roadmap, Industry Canada, August 2005.
- National Metal and Materials Technology Center, Thailand, Fuels and Fuel Technologies in Thailand: Current Status and Recommendations for the Future, December 2004, ISBN: 974-229-712-6.

City 2030 – Shaping the City of the Future Guiding Principles, Scenarios and Concepts

Authors:	Werner Reutter / werner.reutter@rz.hu-berlin.de			
Sponsors:	Federal Ministry of Education and Research			
Type:	National - covering all S&T fields and the entire territory of a country			
Organizer:	Projektträger Bauen und Wohnen, Bundesministerium für Bildung und Forschung; Deutsches Institut für Urbanistik (German Institute of Urban Affairs)			
Duration:	2000-2005	Budget: € 15 Mill.	Time Horizon: 2030	Date of Brief: July 2007

Purpose

In the year 2000 the German Ministry of Education and Research initiated a programme inviting German cities to create principles and models for their long-term development. In cooperation with scientific institutions and experts, the cities were not only supposed to envisage possible or likely future scenarios, but also were asked to think about the goals they wanted to accomplish and criteria to evaluate their progress. All in all, the research network functioned as a research and learning laboratory. Not only cities participating in the exercises were able to profit from Cities 2030, but also cities and regions not participating in the programme benefited from the exchange of ideas and concepts.

Planning Cities' Futures

German cities are being transformed by structural changes that will alter urban life in the next two decades. It goes without saying that these developments have increased the cities' need to adjust to these changes. However, cities and their administrations are accustomed to focusing on contemporary issues and short-term goals. They find it difficult to spend time and resources on reflecting on long-term concepts or guiding principles. But, if cities want to deal with these changes, they will have to develop sufficiently simple and straightforward visions and scenarios to direct political and social change. Cities will have to conceive an idea of their future envisioned in the year 2030. They will only be able to shape and influence their development using such a scenario. This is where the project "City 2030" kicks in: it provides cities with resources and expertise to reflect on and develop long-term concepts, guiding principles or scenarios. Basically this means returning to traditional concepts of urban planning, in spite of the fact that structural dilemmas are inherent therein.

Urban Planning Dilemmas

It is strange, but although modern societies seem destined for change, they ignore the future at the same time. Social, economic or political changes are taking place at an increasing rate, while the capacity of cities to plan for the future is waning. As far as urban planning is concerned, one can identify three dilemmas:

- "Knowledge dilemma": Basically we are aware of the questionable validity of previous knowledge, of its continual renewal and expansion. Nonetheless, planning is carried out under the assumption that it is possible to apply current knowledge to future problems.
- "Democratic dilemma": From a democratic point of view, politicians' decisions should be legitimized by the people affected. However, this would rule out long-term planning, which necessarily has an impact on the living conditions of people not yet born.
- "Innovative dilemma": Planning aims at setting up rules, norms and legally standardized procedures – exactly those structures that undermine a society's capacity to innovate.

Combined, the three dilemmas add up to what can be called "future dilemma". This dilemma is due to structural contradictions inherent to urban planning.

"City 2030" also had to tackle this problem. But it did so only in an indirect way by enabling cities to develop their own visions and ideas according to their regional and urban needs. More importantly, these visions did not have to be implemented. They were not required to be "practical" in the sense that they had to be "tested" in reality. On the contrary, the project's overall goal was to liberate the participants from this burden and to set up a sort of laboratory, leading to new ideas and concepts.

"City 2030" is, therefore, not about implementing academic concepts. Rather, it should be viewed as providing an opportunity, enabling cities to reflect on their current state of affairs, to identify problems ahead and generate ideas for the future. In short: "City 2030" aimed to set up a research network and to match "theory" of urban planning with "practice" of urban politics and administration in Germany.

Research Laboratory: Matching Urban Planning Theory with Urban Political Practice

"City 2030" was started in the year 2000 with an invitation to tender. 110 cities submitted proposals; 21 of these were eventually accepted without further evaluation.

A successful proposal had to link local politics with public administration and academic expertise. A city required an academic partner in order to receive funding. Accordingly, academic institutions necessitated a city as a local partner. This kind of "top-down cooperation" was intended to foster a synthesis between local practice and scholarly expertise.

Furthermore, the contents of a successful proposal had to meet three criteria. Firstly, a proposal had to address one of the concerns identified by the ministry as among the most challenging: i.e. integration, identity or regionalisation.

Secondly, the research network as a whole had to include a number of shrinking cities in order to find solutions for such demographic changes. Thirdly, the size of the cities had to be taken into account, too. Consequently, proposals from cities of varying size (big, medium-sized and small) were accepted.

	Integration	Identity	Regionalisation
Big cities >250,000 citizens	Stuttgart Munich		Karlsruhe
	Bremen Leipzig	Mönchen-gladbach	Braunschweig Städteregion Ruhr
Medium-sized cities Between 50,000 and 250,000 citizens	Esslingen	Erlangen	
	Saarbrücken	Kiel	Görlitz/ Zgorzelec Gießen-Wetzlar
Small cities <50,000 citizens	Dietzenbach	Günzburg	Schkeuditz
		Guben/Gubin Eisenhüttenstadt Beeskow	Schwalm-Eder-West

Note: Names in italics indicate shrinking cities.
Source: Deutsches Institut für Urbanistik

Fig. 1: Cities involved in the project

Cities Involved

Based on the overall goals of the project, the cities participating in the project were distinguished according to size, region and demographic prospects.

- As mentioned, eight cities have a population over 250,000, six between 50,000 and 250,000, and seven less than 50,000 (see table).
- Regionally, the cities are located in 10 out of 16 German states (Länder). Nine cities belong to prospering South Germany, being: Munich, Günzburg, Erlangen (all three are in Bavaria), Dietzenbach, Stuttgart, Karlsruhe, Esslingen (all four are in Baden-Wurttemberg), Gießen-Wetzlar, Schwalm-Eder-West (these two are in Hesse). Mönchengladbach, Saarbrücken, Städteregion Ruhr are located in Northrhine-Westfalia and Saarland, i.e., in states hard hit by economic restructuring in the past three decades, mainly due to fact that the coal and mining industry has been downsized or has totally vanished. Bremen, Kiel and Braunschweig are situated in the northern states of Bremen (which is a city-state), Lower Saxony and Schleswig-Holstein. They, too, face economic problems. Finally, six cities are located in former East Germany, three in Brandenburg (Eisenhüttenstadt, Beeskow, Guben/Gubin) and three in Saxony (Schkeuditz, Leipzig, Görlitz/Zgorzelec). It is worth mentioning that three border cities were included (Guben/Gubin, Görlitz/Zgorzelec, Karlsruhe), and all three addressed this specific situation.
- As a rule of thumb, one can say that economic problems trigger or intensify demographic problems. Hence, it is not surprising that cities experiencing deindustrialization and high unemployment are mostly also shrinking.

Apart from the various aspects of demographic changes (e.g., immigration, older people, a shrinking population), the cities' forecasts addressed the following problems:

- deindustrialisation (Kiel, Eisenhüttenstadt, Mönchengladbach),
- modernisation of medium- and small-sized cities in rural areas (Günzburg, Erlangen, Beeskow),
- cooperation between cities (Guben/Gubin, Braunschweig, Gießen-Wetzlar, Görlitz/Zgorzelec, Karlsruhe, Scheuditz, Schwalm-Eder-West, Städteregion Ruhr),
- sustainability (Munich),
- integration, participation and social justice (Bremen, Dietzenbach, Esslingen, Leipzig, Saarbrücken, Stuttgart).

Exploring Cities' Futures

Needless to say, different, even conflicting models and scenarios were eventually presented. Each city had to define the problem at hand based on regional and local circumstances. The same is true for the models and scenarios that also had to fit into the local or regional environment. Consequently, the tentative way in which ideas and visions were developed makes it difficult to apply them to other cities, especially as none of the concepts have been put into practice. Nonetheless, the project led to a number of ideas that other cities might refer to and adapt to their needs. Altogether scenarios and models were discussed in six areas:

- identity and image
- regionalisation
- integration
- demographic change and shrinking cities
- citizen participation
- gender mainstreaming

Four of these shall be described in more detail.

Dealing with Shrinking Cities

Until the mid 1990s nobody could imagine shrinking German cities. The very nature of cities, by necessity, seemed to embrace a steady growth in many respects. However, due to suburbanisation, increasing mobility and demographic changes, shrinking cities have not only become a widespread reality in East Germany, but also in West Germany. Therefore, more than half of the cities involved in the project (13 out of 21) addressed respective issues.

It is a difficult problem to tackle with optimism. A declining population is always viewed critically. The different concepts presented by the cities clearly reveal this difficulty.

- Leipzig, e.g., stressed the fact that some parts of the city will be shrinking while others will be growing and expanding. This uneven development will require urban planning and adjustments to the infrastructure.
- Other cities (Eisenhüttenstadt, Guben/Gubin, Beeskow) want to establish and nurture a specific identity that is expected to help retain long-established citizens and will hopefully attract new ones.
- A more sombre picture was drawn of Braunschweig-Salzgitter-Wolfsburg, where a perforated city-landscape is foreseeable.

On the whole, the project highlighted the inadequacy of simply remodelling the urban landscape to combat the problem of shrinking cities. Long-term concepts must be set up. In addition, the research network revealed that local politicians as well as administrators are sometimes reluctant to discuss this kind of long-term problem, partly because they are tied up by more pressing short-term issues, partly because of the difficulty in doing something about it. Very often the experts involved in the project had to put the topic on the agenda.

Identity and Image

Urban or regional identities are complex concepts. And one could even argue that cities do not have such a thing as an identity. Nonetheless, seven of the cities participating in the project addressed this topic. Notably cities with identities shaped by the industrial age and the features of mass production regarded the question of identity – or the loss of it – as a challenge. For these cities the project was a perfect opportunity to reflect on a post-industrial image, combining urban flair with local traditions and cultural events. In essence, to find or model a new identity proved to be a quest to create a unique selling point. Again, the cities presented different concepts. Three examples suffice.

- Kiel's major economic sectors (navy and shipyards) have lost their importance, leaving the city without an economic backbone. Being an integral part of the city of Kiel, the sea was to be transformed into a new point of reference for the city's self-image.
- Guben/Gubin faced a twofold problem: its location at the German-Polish border and the fact that it is a shrinking city. In addition, as downtown Guben was destroyed during the war, the city can neither resort to tradition nor to an architecturally integrated city centre. But these problems can also provide a basis for a new city image. Recreating and rebuilding the city's core can potentially comprise a new identity. Furthermore, Guben/Gubin could picture itself as a bridge between two nations.
- Beeskow rediscovered its history and tradition, capitalizing on nature and its rural environment. In short, it sought to combine history and modernity.

These examples show that the cities strove both to conserve their local heritage and tradition, on the one hand, and to embrace features of a modern post-industrial society, on the other. However, images and identities can only work effectively if they are clear and explicit. In addition, an image can neither be created artificially nor can a city easily get rid of an established one. On the contrary, Günzburg, for example, demonstrated that its image was not affected by the establishment of a large new factory. It basically continued to be a small, quiet city in a rural area.

Networks and Regionalisation

Globalization has increased the importance of regions and devaluated cities as the basis for economic and social developments. Similarly, individual mobility has enabled citizens to use the regional infrastructure and combine the advantages of rural and city life. Finally, many problems require cooperation between cities. Nonetheless, cities have legally and politically defined borders.

In the framework of the research network "City 2030", a number of aspects related to regionalisation were discussed. For example, cities can be dissolved and blended into a region. Hence, cities would lose their political and legal autonomy. Another option discussed in the network focused on cooperation between cities. This means that a city would retain its legal and political status but regionalize its scope of action by cooperating with other cities and local communities. Such an approach would necessarily raise the issue of the need for regional identity.

On the whole, the project disclosed two basic options in dealing with regionalisation. Cities can either transform themselves into a kind of regional community or set up a system of cooperation with their neighbouring cities.

Social Integration

Increasing social inequalities and immigration might lead to segregated cities, which, of course, will also result in differentiation between prosperous and declining city quarters. Hence, integration will become a pressing aim to be pursued by cities different ways. Esslingen, e.g., focused on citizens' participation. The city organized a number of panels and discussions, inviting citizens living in the respective quarters to participate and voice their expectations. Munich, on the other hand, gave preference to measures that foster and support families and children.

All and all, it was shown that cities must pay special attention to integration, which also involves the underpinning of increased citizens' participation, voluntary social services and expanded public social services.

Policy Implications: Long-term Concepts Needed

"City 2030" did not include policy recommendations in the sense that local government should implement measures laid down in the various projects. The implementation of policies was deliberately not part of the projects in order to stress the laboratory character and to give the cities as much leeway as possible. The overall goal of the project was to initiate a discourse in the cities on guiding principles, scenarios and models. In consequence, no follow-up project was planned.

However, the strength of the research network marked also its weakness. Some projects ran into a number of problems. Notably the cooperation between local practitioners and academic experts turned out to be difficult and sometimes unmanageable. In a few cities the failure to cooperate and communicate led to a breakdown of the whole project, in other cases the conflicts could only be solved by mediation.

Nonetheless, the successful projects sent out a clear message to local policy-makers as well as to academic experts: if cities want to have a say in their own future, they must have long-term concepts transcending day-to-day business reality.

Sources and References

(available only in German)

- Auf dem Weg zur Stadt 2030 – Leitbilder, Szenarien und Konzepte. Ergebnisse des Forschungsverbundes "Stadt 2030", Bonn/Berlin 2004, in: http://www.stadt2030.de
- <http://www.bmbf.de>
- <http://www.difu.de>
- <http://www.tuvpt.de>

Key Technologies for France 2010

Authors:	Hugo Thenint - Louis Lengrand et Associés (LL&A) / hugo@ll-a.fr			
Sponsors:	French Ministry of Industry, General Business Directorate			
Type:	National - covering all S&T fields and the entire French territory			
Organizer:	French Ministry of Industry – carried out by a group of consultants selected through a call for tender (Erdyn, Futuribles, Cybion, Biotics, Virtuoz)			
Duration:	2004-2005	Budget: Unknown	Time Horizon: 2010	Date of Brief: Aug. 2007

Purpose

"Key technologies 2010" is the third edition of a process, launched in 1995 by the Ministry of Industry. However, it differs from the previous exercises with regard to its objectives, target and methodology (design, dissemination and monitoring). "Key Technologies 2010" results in a characterisation and prioritisation of a list of key technologies according to the long-term appreciation of their impact on the development of activities identified as being structuring for France. The methodology developed within this exercise includes information collection and analysis, interviews with stakeholders from ministries and research organisations, the implementation of working groups and a strong collaboration with regional actors.

Key Technologies to Improve French Competitiveness and Attractiveness

In the globalised economy, France's competitiveness has become a major issue and has been put at the heart of economic actors' priorities. The two first "Key Technologies" exercises published in 1995 and 2000 by the French Ministry of Industry intended to help enterprises in appreciating the technologies to be developed and acquired domestically.

With an emphasis predominantly placed on public actors, "Key Technologies 2010" pursues a distinct goal as it ultimately attempts to determine how France can distinguish itself and stay among the most competitive and attractive countries by investing in specific groups of technologies.

Therefore, the study aims at answering two main questions:
- What are the technologies which will give France a competitive edge and increase its attractiveness in the world in 5 to 10 years?
- What orientations do public actors have to adopt to meet these objectives?

The goal of the study is to lay the groundwork for decision-makers to base decisions on, in particular territorial economic development stakeholders. The final product of this work provides landmarks and keys for arbitration, allowing the most to be made of public investments.

Focus on Sectoral Application and Geographical Matters

Using a mix of deskwork and fieldwork, the project proceeded in three phases and lasted twelve months. All along the three phases, the team focused on demand-driven technologies and potential sectoral applications and studied these issues on three geographical scales:

- An international and European dimension: this approach has enabled to integrate positioning criteria and to consider mobility and localisation of activities in a global context. Potential technologies for international and European collaboration were also identified;
- The national field: the national territory provided the framework for implementing the orientations, given that the French State is the main addressee for proposed action;
- Territorial scales, such as regions, were also viewed as actors in economic development and as future users of the instruments developed by the study.

Phase 1: Project Preparation and Orientation

This phase consisted of collecting and analysing economic, strategic and technological information, and interviewing stakeholders of ministries and research organisations.
A call for tender and a website were also launched in order to recruit about one hundred experts.
At the end of the period, the project framework and the methodological tools were defined and the team had already

analysed the socio-economical context and identified main technological trends and breakdowns.

Phase 2: Technico-economic Diagnosis

This phase aimed at identifying the position of France in the technico-economic context and forecasting potential technological breakdowns' impacts on the French economy.

For this critical phase, a regional platform was organised in order to collect the knowledge and opinions of various private and public stakeholders. Besides, eight working groups were constituted in line with concepts of technology demand and application (intermediary products, communication, mobility, services, etc.). These groups were solicited four times to successively discuss the following matters:

- socio-economic issues and sectoral implications,
- French main economic activities and technological needs,
- technological needs to key technologies,
- key technologies and regional issues.

Phase 3: Characterisation of Key Technologies

Each of the identified key technologies were specified and characterised according to a range of criteria which were:

- emerging issues,
- potential impact on attractiveness and competitiveness,
- market applications,
- market dynamism,
- stakeholder characteristics.

During this phase, the future was particularly emphasised: experts were asked to evaluate the maturity of these technologies in France and their prospects of development by 2010. Pioneer regions were also identified.

Finally, key technologies were hierarchised and public investment priorities defined.

Main Challenges for the Next 10 Years

Identifying Emerging Technologies and Potential Impact on the French Economy

Considering the main socio-economic issues and technological needs in the next five years, the project team managed to identify 83 key technologies for the French economy. These technologies were analysed as described in phase 3 and ultimately organised in the following manner:

Information and Communication Technologies:
Key technologies for France's competitiveness were identified in these areas:

- equipment and communicating systems: microenergy, data storage, processors, RFID, etc.;
- development of software and applications: tools and methods for developing information systems (e.g. simultaneous conception, complex systems engineering, etc.);
- data transport and distribution: virtual networks, data protection, diffuse networks;
- information collection and processing: interoperability, data mining, semantic web, etc.;
- human-machine combination: virtual reality, 3D, simulation, user interfaces and ergonomics.

Materials and chemistry:
Outlooks for these sectors have strongly evolved during the past ten years because of environmental concerns, emerging technologies and increasing competition with developing countries. Broadly, techno-organisational developments, such as industrial platforms, are specifically recommended for these sectors in order to diversify and optimise the uses of raw materials, save energy and share technologies.
Identified key technologies are:

- nano-structures,
- non-conventional materials and new assembling processes,
- new surface treatment processes,
- catalytic processes,
- industrial bio-technologies,
- analytical chemistry,
- microtechnologies.

Buildings:
The development of activity in this area was analysed with regard to conflicting issues such as sustainability, comfort, cost effectiveness or safety. Key technologies deal with both construction processes and materials:

- building structures and envelopes,
- the use of composite materials,
- air, water and moisture management in buildings,
- integration of renewable energy production and energy efficiency.

Energy and environment:
Although France is one of the world leaders in energy production and water management, it will nonetheless have to double its effort in R&D in order to face increasing global competition in these strategic sectors. Most critical targets for technological research are:

- photovoltaic systems with energy storage;
- improvement of wind energy (mapping, meteorology, offshore, noise reduction, etc.);
- synthetic fuels from biomass;
- third generation nuclear reactors;

- heat pump and heat distribution efficiency,
- high efficiency lighting components and systems,
- pollution measurement systems,
- waste biodegradation and energy valorisation,
- etc.

Agro-transformation and pharmaceutics:
Research and innovation in these sectors will only occur after a general consensus – companies, public authorities and customers – is reached. Main concerns are related to public safety, disease prevention, ageing and nutrition. Both sectors are likely to interact through the development of food with novel bioactive compounds that can be used to treat disease or allergies. Most identified key technologies refer either to:

- genomics: transgenomics, gene therapy, functional genomics, genomics screening and recombination vaccine,
- or biochemistry: monoclonal antibodies, cellular therapy, proteomics, etc.

Transport:
Each different transport mode faces the same issues such as the reduction of environmental spillovers, cost optimisation or system security. To this respect, three categories of technological changes should be supported:

- Motors and turbo-compound engines: thermodynamics, combustion efficiency and thermal conduction, etc.
- Architecture and materials for vehicles: noise reduction, weight reduction, passive safety, etc.
- Intelligent systems: vehicles' active safety, intelligent road infrastructures, car positioning and traffic control, automated air traffic control systems, etc.

Distribution and consumption:
Amongst the main issues related to distribution and consumption, the development of new services, the struggle against counterfeit and the protection of public safety call attention to traceability management and authentification technologies.

Specialization in Complex Systems to Stay Competitive

Beyond the description of the 83 key technologies, some main technological trends and issues have been identified by the different working groups participating on the project. All long-term projections notwithstanding, an important part of the mentioned technologies are indeed already well-known. For most of them, research efforts have been suspended because of the availability of cheap energy and abundant raw materials. Henceforth, increasing R&D should be deployed on engines, heat pumps, building materials, etc.

On the other hand, some other potential technologies such as fuel-cells were not chosen because of important barriers to their development in a short-term horizon.

The list of key technologies has been restricted to 83 (136 in 2000), the selection having been based on their significance for French competitiveness and global competition. Therefore, the objective was to identify distinguishing technologies in order to consolidate France's attractiveness and competitiveness. In this context, it has been concluded that French industry would need to specialize in complex systems to remain competitive. For example, France cannot compete in the microprocessors market, but can specialise in application-specific processors such as aircraft computer systems.

It has been acknowledged that some components of these technological systems are likely to be produced in foreign countries, whereas the expertise in terms of conception and commercialisation will stay in France.

Social and environmental externalities are nowadays issues that cannot be ignored. Accordingly, this study underlines the importance of developing technologies allowing minimizing the cost of these externalities or even to monetarise them. It has, however, been noticed that these issues may have been overestimated because of current debates as ICT was overrepresented in the previous studies.

Designing a Decision-making Tool for Public Actors

Final recommendations and forecasts, disseminated in November 2006, have contributed to providing landmarks and key answers to arbitration and optimisation of public and private investments.

The Importance of Regulation for Emerging New Technologies

For an important number of key technologies, normalisation and legislation has an important role in industrial exploitation and commercialisation.

Originally, norms were defined a posteriori in order to develop a common language and to enhance the technological products' interoperability and compatibility. Normalisation is nowadays considered as a competitiveness factor for firms that have managed to inflect the normalisation process towards their own standards.

However, French companies have a great lack of experience compared to Anglo-Saxon or German firms, especially at the European level. Hence, the capacity to anticipate and to participate in standardisation procedures is an important short-term issue for French industry.
In a broader term, legislation has become a major concern with respect to genomics and cell culture. If France, ideally

Europe, does not rapidly reach an agreement on these issues, it will be very difficult to catch up with the competition.

Better Targeting for Public R&D Investments

In terms of identification of priorities, the eight working groups involved in this exercise have identified competitiveness and attractiveness factors to be emphasized as well as major strategic orientations to be adopted.

Their work has notably enlightened cluster projects, major innovative technological projects and diffusion of technologies in industries with a particular emphasis on SMEs.

As the project overlapped with a French public programme aimed at supporting technological & industrial clusters (pôles de compétitivité), the team analysed the presence or absence of key technologies in those clusters.

Most of the key technologies are included in at least one cluster but 8 key technologies, mainly ecotechnologies (waste management and sustainable buildings) are still not developed by any cluster. Twenty key technologies are linked to more than 5 clusters. This situation could lead to inefficient public funds allocation and a lack of competitiveness.

Besides these clusters, the French National Agency for industrial innovation strategy ought to take the project output into consideration in prioritising their grants and subsidies. Heavy investment should thus flow to key systems such as open rail networks, noiseless and energy-saving airplanes, industrialisation of software programming, etc.

The Follow-up

Two potential paths for this project's continuation were proposed.

First, the European dimension has been stressed by the project team in recommending to connect this foresight exercise with Community initiatives such as the study published by the European Commission Key technologies for Europe in September 2005.

On the other hand, launching a systematic update process of this study at the national and regional levels is also recommended. To this respect, the network of experts established for the project shall be maintained through the project's website, the publication of a newsletter and by holding a workshop twice a year.

Sources and References

Transport 2050 final report: http://www.equipement.gouv.fr/IMG/pdf/report_cle1db135.pdf

Futuribles Think-Tank report: http://www.equipement.gouv.fr/IMG/pdf/prosp.tr.2050_-_rapport_vljuin.05_cleoefd4b.pdf

The Future of the Dutch Natural and Built Environment

Authors:	Susan van 't Klooster / susan.van.t.klooster@ivm.vu.nl Jan Schuur / schuur@rpb.nl			
Sponsors:	Netherlands Environment Assessment Agency (MNP); Netherlands Bureau for Economic Policy Analysis (CPB); Netherlands Institute for Spatial Research (RPB)			
Type:	National foresight/scenario exercise			
Organizer:	MNP, Leon Janssen, leon.janssen@rivm.nl; CPB, Ruud Okker, v.r.okker@cpb.nl; RPB, Jan Schuur, schuur@rpb.nl; www.welvaartenleefomgeving.nl			
Duration:	2004-2006	Budget: NA	Time Horizon: 2020 and 2040	Date of Brief: Jan. 2007

Background

The purpose of this scenario exercise is to support the Dutch national government in the development of policies on spatial planning, natural resources, and quality of the physical environment. By exploring how various aspects of the living environment and land use in the Netherlands may develop in the long run (2040), the study aims to show when and where current policy objectives may come under pressure and which new issues may emerge.

Societal Trends Effecting the Natural & Built Environment

Long-term trends, such as decreasing household size, ageing population, international migration, economic growth, and increasing personal welfare, will change the Dutch natural and built environment significantly. This national foresight exercise analyses the combined impact of these trends on various aspects of the Dutch urban and rural landscape, including residential and industrial land use, traffic and transport, energy, agriculture, nature and landscape, water safety, and environment and health. Quantitative forecasts illustrate these trends as well as their effect on the natural and built environment.

Evaluating the Long-term Effects of Current Policy

The study assesses the long-term effects of current policy, given the international economic and demographic context of the Netherlands. Its qualitative and quantitative results should serve as a reference for policy-makers addressing spatial planning, housing, natural resources, infrastructure, and the environment. By exploring how land use and various aspects of the living environment may develop in the long run (2040), the study shows when current policy objectives may come under pressure and which new issues may emerge.

Scenarios and Extensive Integrated Modelling

The long-term future of the Dutch population and economic development and, consequently, of its natural and built environment is highly dependent on international factors. Two critical factors of uncertainty stand out: (1) To which extent will nations and international trade blocks cooperate and exchange, giving up some of their cultural identity and sovereignty? (2) How will governments strike a balance between market forces and a strong public sector? These international political choices determine four possible scenarios for the Netherlands:

- Strong Europe: emphasis on international cooperation and public responsibilities.
- Global Economy: emphasis on international cooperation and private responsibilities.
- Transatlantic Markets: emphasis on national sovereignty and private responsibilities.
- Regional Communities: emphasis on national sovereignty and public responsibilities.

The study builds on earlier work by CPB (2003, 2004) and MNP et al. (2004) in which these scenarios were translated into four development paths for the Dutch economy and demography. In the current project, the resulting economic and population scenarios, including their international contexts, were elaborated for application to the built and natural environment. This required both conceptual thought and extensive integrated modelling, e.g. regarding the coherence and consistency of all different aspects of regional economy, internal migration, urbanization, and environmental pollution. The modelling framework generated quantitative indicators to illustrate the scenarios and support the conclusions.

Scenarios should include realistic options for national policy. To allow for statements on the future effects of current government policy and to compare these with alternative policies, trend-based policy is assumed in all scenarios. However, in the long run, the four scenario contexts will diverge too much for a uniform policy to be realistic. Consequently, beyond 2020 policies may slightly differ among scenarios, as long as they are plausible and consistent with the scenario logic.

Future Problems, Bottlenecks, Challenges and Opportunities

The Increasing Demand for Space Will Level Off

Due to smaller population growth new demand for housing, industrial land use, traffic and transport will level off after 2020. As a consequence of a decreasing labour force and a growing service economy, in three of four scenarios there will be no significant need for greenfield locations for industrial estates and business parks after 2020.

Population growth will slow down and in one scenario even turn into a population decrease. Yet income per capita will continue to rise in all scenarios. Both developments may provide incentives to improve the quality of living, for example by restructuring the built environment.

Living Quality and Safety Issues

Smaller population growth may have negative side-effects like abandoned residential and industrial areas and deterioration of city quarters, if investment policies do not adjust. In addition, immigration flows will have a substantial impact on city size and urban population. The concentration of migrants with little education in cheap housing areas of a few main cities offering limited labour market opportunities to this group may lead to social segregation.

(Inter)National energy consumption and, consequently, the emission of greenhouse gases will continue to grow. Climate change is expected to impose major water safety challenges, especially in the areas below sea level where urbanisation will proceed most rapidly. The countryside landscape will change too: agriculture will be under pressure not only from growing urbanisation and demand for recreational facilities, but also from increasing competition on international markets, leaving little room for acting in concert with nature. In other parts of the countryside, however, current ecological investment policies will pay off and leave large areas for nature preservation.

Increasing Environmental Exploitation in spite of Decreasing Population

Housing
The highest demand for housing will continue to be in the highly urbanized Randstad area. In order to avoid the degradation of city quarters, the Dutch government should aim to restructure and improve housing quality.

Industrial land use
Restructuring will also become a priority in industrial areas. In most scenarios there will be no further need for additional industrial estates after 2020. A growing service economy will gradually transform many industrial estates into business parks. As a result, environmental risks will decrease, but traffic will grow.

Traffic and transport
In the majority of the scenarios, highway congestion will cease to increase after 2020, as a result of current road building programmes and saturation in car use. In scenarios with considerable economic and population growth, mobility will increase, especially freight transport. It is expected that congestion will remain primarily a problem of the Randstad area.

Energy
Dutch energy consumption may increase up to 50% by 2040 in case of high economic and population growth. Renewable energy will remain more expensive than fossil fuels and therefore dependent on state subsidies. As a result of gas stock depletion, the Netherlands will become more dependent on importing coal and petroleum. This requires policies that guarantee sufficient energy supply.

Agriculture
In the agricultural sector, scale enlargement and specialization will continue. In scenarios with agricultural market liberalisation and abolishment of milk quotas, stock farming will increase significantly, partly at the expense of arable farming. As a result, competition between agriculture and nature preservation will increase. By 2040, 10 to 15% of the current agricultural area will be spatially transformed.

Nature and landscape
Biodiversity will continue to be under pressure, especially in large-scale, intensive agricultural areas. Bird populations will be affected first. Under strict European ecological policies

environmental pressures will decrease and existing nature areas may partly recover. Desiccation, on the other hand, will continue to pose problems on nature areas.

Water safety
Climate change will enhance flood risk and chances of water damage. The lowest parts of the Netherlands, which are more densely populated and highly urbanized, are most vulnerable. Water safety norms should be related to population size and investments to be protected, thus corresponding to population density and urbanisation.

Environment
Air quality will generally improve, apart from the CO_2 emissions, which can be expected to rise without international climate policy. If current emission levels are maintained, the risks of climate change will continue unabated.

2020 Will Mark a Turn for Dutch Society and Politics

The study holds the following messages for Dutch policymakers.

New migrants will have a major impact on new land use, in particular for housing, infrastructure, recreation areas and industrial land use. Demographic and economic growth is mostly determined by future immigration flows.

After 2020 traditional issues regarding the natural and built environment may lose urgency. Congestion growth will level off, air quality will generally improve, and the need for new housing, industrial estates and business parks may disappear. The impact of these trends will be felt at a regional level first. The effects may be both negative (abandoning of residential areas and industrial estates) and positive (opportunities to improve quality of life).

Other issues in the built environment may become more urgent. The growing share of non-European migrants in the Dutch population may increase existing mismatches in urban housing and on labour markets and generate social conflicts. Climate change will continue to be a persistent environmental problem; in the long run the rising seawater level and river runoff will create a water safety problem.

There is a risk of overinvestment. New infrastructure, residential areas and industrial estates require long-term planning and once established may last for several decades. In a population decrease scenario these investments may become obsolete within a decade after realisation, leading to local problems of decay of the built environment. Given the duration time of these investments, the social cost of public investment policies based on continued growth may exceed social benefits.

The composition of the population and households will change due to demographic developments, like ageing, immigration, and household size reduction. Single, old-aged and migrant households will grow considerably, especially in the main cities. This will affect regional labour markets, housing demand and the nature of commercial and social services.

European policy will become more influential. Further integration of the European labour market and a shift in European immigration policy will affect the size and composition of the Dutch population and the demand for housing, employment, recreation, etc. Common EU agricultural policy will change the agricultural landscape. In addition, European environmental policy may have an influence on future spatial developments. In the Dutch situation, which is characterized by high population density and intensive land use, European environmental regulation and standards may cause local conflicts between housing and infrastructure or agriculture and nature development. Finally, the national gas reserves will gradually run down; Dutch energy supply will be more dependent on imports and thus on international political cooperation.

Strategies

This study does not intend to make policy choices. Instead it presents an approach that may support policymakers in developing robust policies and setting priorities.

Robust policies
Some trends are relatively certain, such as the demographic change after 2020, the proportional increase in population age, household size reduction, increasing personal incomes and climate change. Other trends, such as the effects of immigration, economic growth and EU policy, are more difficult to predict. Policymakers are challenged to apply flexible and robust strategies that allow for such uncertainty.

Balancing social costs and benefits
In the absence of a robust strategy, policy makers will have to make a choice. Such a policy choice should include an analysis of future social costs and benefits of both options, the assessment of short and long term risks, and the effects for different generations, population groups and regions. The four scenarios and the quantitative data presented in this study provide useful instruments for such a cost-benefit analysis.

Sources and References

www.welvaartenleefomgeving.nl

CBS/ MNP/ ABF/ RPB en CPB (2005). Scenario's voor huishoudensontwikkeling in Nederland, Voorburg/ Bilthoven/ Den Haag.

CPB (2003). Four Futures of Europe. Centraal Planbureau, Den Haag.

CPB (2004). Vier vergezichten op Nederland, productie, arbeid en sectorstructuur in vier scenario's tot 2040. Centraal Planbureau, Den Haag.

RIVM/CBS (2004). Lange-termijn bevolkingsscenario's voor Nederland. Rijksinstituut voor Volksgezondheid en Milieu / Centraal Bureau voor de Statistiek, Bilthoven / Voorburg.

Norway's OG21 – Oil and Gas in the 21st Century

Authors:	Jan Erik Strand / Jan.Erik.Strand@hydro.com Aud Alming, Research Council of Norway / aalm@rcn.no			
Sponsors:	Norwegian Ministry of Petroleum and Energy, Research Council of Norway, the Norwegian petroleum cluster			
Type:	Strategy for concerted R&D effort in Norwegian petroleum industry, initiated by the Norwegian Ministry of Petroleum and Energy			
Organizer:	Norwegian Ministry of Petroleum and Energy			
Duration:	2001-ongoing	Budget: NA	Time Horizon: approx. 2100	Date of Brief: March 2007

Purpose

The objective of the Norwegian foresight process "Oil and Gas in the 21st Century" was to assess the possibilities for a sustainable petroleum industry for the next 100 years through joint efforts concentrating on knowledge and technology.

Research for Norway's Energy Future

Norway's objective is to create maximum value for society by exploiting Norwegian Continental Shelf hydrocarbon resources. Global energy demand is soaring as never before, driving economic growth. Future growth will be underpinned by India's and China's economic development, which has been forecasted to account for about 40 percent of world economic growth altogether over the next quarter of a century. According to the International Energy Agency, global energy requirements could increase by as much as 60 per cent in the next 25 years. A broad range of energy options will be needed to meet this demand. Despite the expected growth in biofuels, wind and solar energy, the only realistic source of energy with the scale and versatility to meet the challenges of growing demands will be fossil fuels. The petroleum industry will also have to address the infrastructure constraints and bottlenecks along the supply chain, from upstream to downstream, to bring oil and gas from the source to the consumer. Major technological progress and investments are called for to satisfy the world's need for energy.

One of the key success factors in the development of an advanced Norwegian petroleum industry has been the willingness to invest in research and development from the beginning. The estimates of the Norwegian Petroleum Directorate show that considerable potential still exists for enhancing the value creation from the oil and gas industry. Fulfilling this potential will depend on a continued commitment to more research and development.

In 2001, in order to push petroleum technology, the authorities took the initiative to establish OG21 – Oil and Gas in the 21st Century. This is a national drive aimed at uniting industry and public research resources in an effort to address the challenges and find solutions ensuring a positive development on the Shelf, as well as aspiring to doubling the export of technology by 2008. OG21 has succeeded in aligning stakeholders behind its strategy work.

Eight Future Visions

The future extraction of resources on the Norwegian Continental Shelf will be demanding. Working on strategies, OG21 has identified eight key challenges crucial to future value creation on the NCS and for enhancing the competitiveness of the oil and gas industry:

- Sustainable development and zero harm to people and the environment.
- Increased reserve replacement rate through exploration, (find more petroleum reserves to replace the amount that is produced).
- Increased hydrocarbon recovery.
- Cost effective technology for Arctic developments.
- Development of marginal fields (fields that require new technology to become profitable).
- Increased value creation from gas.
- Future competence development and increased recruitment to the industry.
- Increased export of technology.

Together, the key challenges will contribute toward meeting technology needs as shown in the road map in Figure 1.

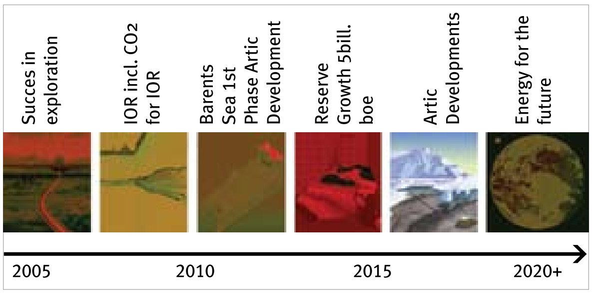


Figure 1: Roadmap for technology needs

Public Private Partnership

In Norway, partnering between the government, oil companies (Norwegian and international), supply industry, research institutions and academia has established a suitable environment for technological developments. The companies have cooperated to develop, test and implement new technological solutions in various projects on the NCS.

Abundant Recoverable Resources

Norway is still a promising petroleum province. Slightly less than one third of the recoverable resources have been produced. Furthermore, estimates show that one quarter of the total oil and gas resources on the NCS remains to be found. The resource potential on the NCS is also significant in an international context. The industry's ability and willingness to apply new technologies will continue to be a driving force in developing this potential, both in the mature parts of the NCS and the still unexplored large frontier areas.

Technological Challenges

Many of the areas that will produce oil and gas in the future are characterized by great technical or logistic risks requiring a long lead-time to develop. Driven by the need to broaden/enlarge the reserve base, oil companies are looking to leverage technology to convert unconventional resources into reserves – this applies to both ends of the API gravity scale, i.e. heavy crude oil and gas.
Additionally, there is a trend towards developing technologies in order to access both conventional and unconventional hydrocarbon reserves in new operating environments such as ultra-deep water, arctic/sub-ice and other environmentally sensitive areas that require an expensive and complex infrastructure. More advanced technology must be mobilized to access new reservoirs and to develop "unconventional" deposits.

Recovering Deep Water & Arctic Resources

The potential for increasing the global recovery of oil reservoirs is significant. The current global average recovery rate stands only at about 35%. A 5% increase in worldwide recovery would bring more oil than Saudi Arabia's reserves. Deep water and arctic resources will grow in importance, but production cannot be ramped up quickly.

OG21 Strategy and Recommendations

The OG21 strategy describes:

- the challenges facing the Norwegian oil and gas industry;
- high-priority target areas necessitating concerted efforts;
- specific actions required to enhance value creation in each of the target areas;
- competence objectives; and a proposal for strategy implementation and execution.

The OG21 mandate sets the direction and vision for the work:

- To generate new technology and knowledge ensuring profitable and sustainable resource development on the Norwegian Continental Shelf (NCS);
- To enhance the industry's international competitiveness by producing attractive new technological products, system solutions and competence.

OG21 objectives are to co-ordinate and concentrate Norwegian R&D efforts to help meet the technological challenges facing the oil and gas industry, as well as to be an effective instrument for enhancing value creation. OG21 itself does not have the means to finance these projects, but serves as a catalyst and an arena where operating companies, researchers and authorities can meet. Figure 2 illustrates the vision, main objectives and key challenges of OG21.

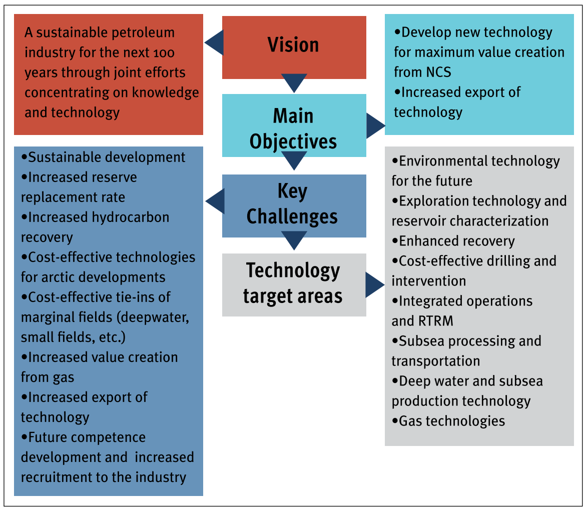


Figure 2: Strategy structure

Low-carbon Diet for the World

The global concerns for the environment are growing. One of the most critical environmental challenges facing the world today is reducing the long-term increase in greenhouse gas emissions. What will it take to put the world on a low-carbon diet? The use of fossil fuels to meet the world's energy needs has contributed to an increase in emissions, primarily of carbon dioxide and methane, into the Earth's atmosphere. This is causing climatic changes, with potentially adverse effects on people, economies and environment, from coastal flooding and droughts to changes in ecosystems and biodiversity. Most governments and businesses agree on the importance of managing the impact of climatic changes. The challenge is how to do so while still providing the energy required to meet the demands of growing populations and economies. Mitigating carbon emissions is a daunting task, with no single solution. However, the development and deployment of technology will play a key role. The issue of carbon capture and storage is high on the agenda, both as a possible way of mitigating climatic changes and from the perspective of increased oil recovery. Development of new energy technologies and innovative solutions that can reduce emissions to air and water has a high priority with OG21. CO_2 capture and storage will not solve the climate problem, but it can play an essential role in the development of a more sustainable energy system.

Sources and References

Strategy Report and sub-strategies for each Technology Target Area can be found on **www.og21.org.**

Regional Foresight Exercise for the Greek Region of Epirus

Authors:	Effie Amanatidou / amanatidou@atlantisresearch.gr			
Sponsors:	Regional Innovative Actions under the ERDF 2000-2006			
Type:	Regional foresight exercise – overview brief			
Organizer:	BIC (Business & Innovation Centre) of Epirus, Katerina Fillipou – Keramida, bicepirus@ioa.forthnet.gr			
Duration:	2005-2007	Budget: € 250 000	Time Horizon: 2021	Date of Brief: July 2007

Purpose

The regional foresight exercise for the Epirus region was carried out as one of the project 'Entrepreneurship through Innovation in Epirus – ENTI' actions (Action 5), funded by the Innovative Actions of European Regional Development Fund (ERDF). The purpose of the regional technology foresight was to go a step further than short- and medium-term analysis and to provide the EPIRUS region with a clearer view on future technological opportunities as the basis for future innovation.

Opting for Entrepreneurship in the Epirus Region

The regional foresight exercise for the Epirus region was one of the main actions of the "Entrepreneurship through Innovation in Epirus – ENTI" project. The ENTI project aimed to develop innovative measures to support entrepreneurship through innovation in the Greek Epirus region. It was based on the results of the Community Support Framework programme for the Epirus region (1994-1999) and on the strategic analysis of the region which took place during the Regional Innovation Strategy Programme.

The analysis revealed several opportunities for improving Epirus's competitive position in the next years. The infrastructures being developed (like the Igoumenitsa harbour, the Egnatia highway, the new local transport networks, the expansion of the Ioannina University infrastructures, the new technology park, etc.), create a totally new environment for the region.

Within this framework, Epirus must better comprehend emerging entrepreneurial and investment opportunities, especially in the service sector, and redirect activities to exploit them.

At the same time, obstacles must be overcome and the factors enhancing innovation need to be nurtured. The firms of the region lack innovation culture. Training in innovation development is essential. The local entrepreneurial potential is weak, characterized mainly by small and non-ambitious enterprises, operating in the local environment. Private capital, either in the form of individual investors or venture capital, must be ensured. Two factors are crucial in this respect: firstly, identifying interesting and well-justified business opportunities, and, secondly, making potential investors aware of those opportunities.

Furthermore, innovative entrepreneurship does not only rely on current opportunities. It also depends on shaping a local economy and technological needs and opportunities that will occur in the future. Today's innovation policy is not shaped in a vacuum, but needs to consider future needs, challenges and trends. Coordination with other national or regional schemes promoting innovation is also essential. Activities promoting innovation in Greece cover most of the economic sectors. Actions like mobilizing private capital and innovative training should be aware of the current development of new entrepreneurs. Opportunities resulting from parallel actions must be identified and exploited.

Mobilization of Actors

Last but not least, innovation promotion and support cannot be developed without a broader awareness and greater mobilization of companies, entrepreneurs, private capital, local actors, and policy makers. In addition, innovation language should not be "difficult", but needs to be comprehensible for all actors called upon to bring in their ideas and other input. Following the preceding context analysis and the consequent results and conclusions, the ENTI project adopted an integrated strategy for regional development, based on innovation along the following axes:

- Recognizing and promoting new investment opportunities as a result of infrastructure development in the Epirus region, and by creating new enterprises, especially in the service sector.
- Pilot implementation of innovative training methods targeting innovation development and support.
- Promotion and diffusion of private capital in the Epirus region.
- Pilot promotion of e-commerce and information management in local enterprises.
- Implementation of a regional foresight exercise.
- Creation of an Interface Committee for Innovation.
- Conducting an awareness campaign promoting innovation.

In the future, the region should act not only as a "passage" to Greece, but be developed as a "gateway" to growth via endogenous development and application of innovative ideas.

From Simple 'Passage' to 'Growth Gate'

The ENTI project reflects the new priorities of the Community Support Framework for the Epirus region (2000-2006), aspiring to develop policy orientations and measures to accelerate innovative thinking and innovation in the region. The 2000-2006 Community Support Framework for the Epirus region includes a well-structured approach toward supporting regional development:

- The development of the region as the new Greek Western Gate to Northern Greece and Europe, and the use of the competitive advantages created by the new transport infrastructures.
- The further development of urban infrastructures and services.
- The development of tourism – the protection and development of the natural and cultural regional resources.
- The sustainable development of non-urban areas.
- The qualitative development of human potential.

Foresight Serving the Local Community: Targeting Transport, Tourism, ICT

In light of the necessity of taking future needs, challenges and trends into consideration in developing innovation policy for the region, ENTI included the implementation of a regional foresight exercise.

The main target was drawing up a framework of directions suited to support regional authorities in designing innovation policy and to help enterprises improve future planning. According to the needs and opportunities identified, the sectors targeted were transport, tourism and ICT. The issues studied referred to Epirus's role as the new gateway to Western Europe, the role of transport and services industry, and the impact of EU enlargement on the availability of Structural and Cohesion Funds, which constitute a major development source for the region.

Challenge Scenarios and Investment Arenas

The main methodology was based on "scenario development". The scenarios referred to possible actions and investment for each thematic area, generally aiming to support regional innovation development policy. The scenario development was the main task of the three expert working groups that were set up (one for each of the three areas targeted). The expert groups worked via internal as well as external consultation workshops. Each of them was asked to organise a consultation workshop for discussing scenarios and another one for disseminating them.

A questionnaire survey was also carried out for each of the study areas, investigating the views of representatives from the local public and the private sectors, as well as other individuals. The aim of the questionnaire survey was to gain feedback on the factors characterizing the scenarios developed as well as on their importance for the region of Epirus, the expected time and feasibility of realization, and their influence on the strategic regional targets. The results of the questionnaire surveys were fed into the working groups.

The increased awareness awakened by the results and their dissemination was the basis of a greater dialogue aiming to raise citizens' and businesspersons' sensitivity towards innovation and technology. Apart from the dissemination workshops organised by each working group, a final conference also took place making the results of the whole exercise generally known.

Three Sustainable Regional Development Options

Three scenarios were developed for each of the thematic areas studied. Each of them was discussed with the relevant public and private stakeholders via the questionnaire survey and consultation workshops. One of the three was selected as the most desirable for the Epirus region. In collaboration with the stakeholders involved, the policy implications and consequent actions to achieve the desired scenario were then defined.

Transport: Towards 'Sustainable Mobility'

The most desirable scenario for the development of transport is based on the existence of an integrated plan and a transportation system development policy, geared toward reduced environmental pollution, increased safety in transport, increased quality of life – especially in the urban areas – and involving citizens in decision-making.

It is important to adapt to EU policies for regional development and transport development. An institutional framework defining areas of public-private partnerships and cooperation is also crucial. Furthermore, the specific scenario calls for extensive initiatives and actions by the regional as well as local authorities to improve services, protect the environment and citizens' quality of life. In this respect, the role of entrepreneurship, research and innovation is relevant. In turn, the upgrading of firms involved in transport is a crucial factor, as is the collaboration between the academic world, research bodies and the business world.

Tourism: From 'Mass' to 'Mild' and 'Innovative' Tourism

The most desirable route chosen for the tourism sector was away from the current 'mass' tourism development model towards a 'mild' and then an 'innovative' tourism model. The 'mild tourism' scenario supports the development of sustainable tourism with cautious interference and respect for the environment, building up a more widespread sustainable development culture. This scenario is based on the distribution of demand throughout the year, the promotion of the economic and cultural wealth of the region, and the integration of tourism within the regional economy such that the entire region may participate in the benefits.

The 'innovative' tourism scenario highlights the development of significant innovations in tourist activities and services. The production and support of new ideas is facilitated by exploiting the demand for new features and trends, as well as forming new demands by launching new products and services. In this respect, Epirus is defined as a new destination for high-quality, specialized tourism (winter tourism, spiritual tourism, adventure tourism, etc.).

ICT: Towards an 'Intelligent Community'

In relation to the development of the ICT sector, the most desirable scenario was chosen to be the 'Intelligent Community'. This is characterised by broad ICT usage in everyday operations in the private and the public sectors, as well as individual households. ICT applications are user-friendly, and citizens use them in a wide range of activities. Transactions with public organizations are easy and fast, aiming to maximise citizen satisfaction.

The 'Intelligent Community' scenario envisaged by the Epirus community reflects the ICT's potentially important role in regional development, enhancing social cohesion, participation and competitiveness.

Social Modification alongside Technological and Institutional Change

In consultation with stakeholders, each working group went further and identified the challenges and issues to be tackled in order to create the required conditions for realising the most desirable scenario. Additionally, consequent policy implications and priorities were defined and concrete actions were suggested.

Transport: Need for Cultural Change

The major factors considered important for realising the 'sustainable mobility' scenario referred to the creation and management of large infrastructure works, ensuring the availability of necessary investment capital, exploiting the positive developments in the Balkans, and accepting the basic principles of the scenario directing consumer preferences.

Human resources were considered crucial in terms of acquiring the necessary skills, knowledge and know-how, as well as increasing citizens' and businesses' awareness and strengthening culture in favour of environmental protection. Life-long learning and information for transport sector employees and its users on issues of new technologies, institutional and transport regulations, e-services, etc. were considered a major factor in making the 'sustainable mobility' scenario possible. General factors, such as creating suitable conditions for market development and competition, improving economic conditions, and setting up and respecting rules protecting the environment, were also noted.

Supporting the development and application of research, technology, know how and innovation in the necessary fields was also considered crucial. In addition, the importance of the development and application of ICTs was also noted, because of their contribution to improving services, increasing the competitiveness of transport businesses, protecting the environment and improving the quality of life, especially in urban areas. In this respect, the important role of the academic and research community of the region was observed, as well as that of the central and regional administration in supporting these developments.

Certain institutional interventions in relation to safety issues were also highlighted, as well as new transport activities and services not burdening the environment. The regional and local authorities were to be strengthened in their role as main actors next to central administration.

Tourism: Towards Developing a Unique 'Product'

The route to be taken by the region is the development of its own tourist 'product', presenting and exploiting distinctive local features, attractions and advantageous sides of the region. Products and services should be specialized and targeted to a specific market segment. However, this must to be preceded by a long period of combining several forms of alternative tourism. In this way, the desired form and particularities can be identified that distinguish the new tourism development model from the current one.

First, a 'mild' tourism development model should be established, which respects the environment while maximizing the value of public and private investments within integrated land-planning. This model should evolve by identifying and developing an 'innovative' tourism model as orientation, characterized by the constant development and application of new ideas.
The mobilization of the region's entire human capital has to be achieved through a common set of objectives which should include at least:

- extending the tourist season;
- attracting high-income tourists;
- increasing demand, especially from Europe, USA, Canada and Australia as well as South-east Asia;
- developing new forms of alternative tourism and enhanced tourist packages; and
- offering services to passing tourists.

The collaboration of all relevant actors is important (administration, businesses, academia and the research community). The same is true for the public and the private sectors (for example, via public-private partnerships). Similarly, given that the tourism sector is quite extensive, the whole community in fact contributes to the development of the final tourist 'product'. Thus, it is important to mobilize all the regional and local authorities in order to sensitize citizens and involve them in defining the joint vision.

ICTs – Still a Long Way to Go

The consultation concluded that the ICT development policy of the region should emphasize the following issues:

- Extension and upgrading of existing communication networks and creation of new infrastructures.
- Promotion of education and training in ICTs.
- Support of research and innovation, and linking them with the market and production.
- Support of local academic and research institutions in terms of both infrastructure and human resources.
- Promotion of the use of ICT in the transport and tourism sectors.
- Supporting the application and use of Geographical Information Systems.

The regional foresight exercise was considered as an important activity towards the creation of human networks, exploration of new knowledge fields and formation of participatory governance.

The results of the exercise were communicated to relevant policy-makers and stakeholders both during the exercise (through the organised workshops and final conference) as well as afterwards. The results were available in time to contribute to the formation of the Region's Development Strategy within the 4th Community Support Framework (2007-2013). Hence, they were disseminated during the consultation phase dealing with formation of the region's development for the next programming period. Round tables were organised at the prefecture level (in all of the four prefectures of the Epirus region). Even though the design of the subsequent actions cannot be attributed solely to the results of this exercise, the view is that the foresight exercise was quite helpful in conceiving the region's future.

Sources and References

http://www.bicepirus.gr/enti/en/program/actions.htm (Action 5)

Horizons 2020 – Mapping the Future of Society, Economy & Government

Authors:	Werner Reutter / werner.reutter@rz.hu-berlin.de			
Sponsors:	Siemens			
Type:	National foresight exercise, covering all S & T fields and the entire territory			
Organizer:	TNS infratest, Munich			
Duration:	NA	Budget: NA	Time Horizon: 2020	Date of Brief : August 2007

Purpose

The report "Horizon 2020 – A thought-provoking look at the future" is a dialogue invitation rather than an attempt to provide another "traditional" strategic scenario very often aiming to lay out a roadmap for a predetermined outcome. The report in question differs from this approach in three respects. First, it aims at creating a basis for dialogue with the public at large. Second, it addresses a broad range of topics covering political, social, economical, environmental and technological issues. Third, the report offers two scenarios on the basis of an expert survey.

Making the Future Part of the Present

Essentially, the future might become part of the present in two ways. "Horizons 2020 – A thought-provoking look at the future" comprises both.

Extrapolation & Technology Roadmaps

The first approach is based on a combination of extrapolating the future from today's world and "retropolating" the present from tomorrow's world. In other words: a future state of affairs is described by applying trends, visions etc., i.e., by extending past and current developments into the future. Respective strategies can then be designed and put into practice in order to accomplish the self-set mission or to achieve the goals laid out in the forecasts. Overall, these scenarios or forecasts are the means to provide a roadmap towards a specified goal. The second part of "Horizons 2020" includes such an approach as "Technology Reports". Prepared on behalf of Siemens, these Technology Reports provide overviews on possible developments in major technology areas. They describe the most likely paths to be taken by production and automation technology, power engineering, healthcare, information and communications, biometrics, materials and nanotechnology, as well as transportation. They are mostly based on trend analysis. The Siemens groups and their research departments use this method to identify future developments and trends that affect Siemens' businesses.

The Technology Reports are based on "Pictures of the Future", a methodology developed by Siemens' Corporate Technology Department. Even though the results and key statements have been included in "Horizons 2020", the full texts of the reports have also been added on account of the additional information provided.

Socially Embedded Technology

Changes do not solely occur because of technological or product innovation. On the contrary, innovations and technological

shifts are deeply embedded in a culturally, socially and politically shaped environment. Consequently, future changes can also gain current relevance in another way. This second approach has been coined the **"communicative scenario".** This type of scenario is not a means to extrapolate a possible or likely future from current developments, but rather a tool that can trigger a public debate about what kind of future we want to live in. Consequently, a communicative scenario differs from classical approaches in three respects:

1. It aims at creating a basis for dialogue with the public at large.
2. It addresses not only technological issues but a broad range of topics, including political, social, economical and environmental issues.
3. It offers two scenarios based on an expert survey.

Siemens contracted TNS infratest Wirtschaftsforschung, Munich, to develop such a communicative scenario. In order to develop and implement long-term strategies, the Siemens Groups also have to take other aspects than economic or technological ones into account. (The brief will be limited to the second approach and thus not address issues dealt with in the Technology Reports.)

Environmental Scenarios and Expert Surveys – Setting Up a Communication Scenario

"Horizons 2020" breaks new ground by combining environmental scenarios with a quantitative expert survey. Methodologically, the research team met the major challenge of qualifying descriptors considered as relevant to describing the future. The process of selecting and qualifying these descriptors included a number of steps and was supervised by an advisory board.

The Expert Survey

Initially, the research defined five important life areas regarded as most important and that were expected to drive changes in the next 16 years (2005-2020). These areas were the political arena, society (values, demography etc.), the economy (economic development, labour market etc.), the environment (environmental awareness, food etc.), and technology (technological developments, power engineering).

Based on this framework, the research team selected 200 descriptors as pivotal to describing these areas. The descriptors were then discussed with the advisory board and split up into three groups (1) ten mega trends, i.e., key developments considered inevitable; (2) non-critical descriptors considered insignificant for future developments; (3) 108 critical descriptors considered decisive in the future by the research team and the advisory board. 116 experts (of 671 originally contacted) then agreed to take part in a survey, which reduced the number of critical descriptors by another 32, leaving 76 critical descriptors in the end.

The Scenarios: Dividing Europe into Four Regions

Geographically, the scenarios focus on Europe divided into four areas. The extents of these areas follow socio-economic criteria rather than national boundaries. **Europe's economic heartland** consists of Germany, Benelux, Austria, Switzerland, eastern and central France, England (but not Wales or Scotland), the western part of Czech Republic, the north of Italy, and the area around Barcelona. **Northern Europe** consists of the Scandinavian countries, Iceland, Ireland, Great Britain (excluding the southeast of England) and the west of France. **Southern Europe** comprises the Iberian Peninsula (but not Barcelona), central and southern Italy, Greece, Cyprus, Malta, and the European part of Turkey. Finally, **Eastern Europe** consists of the new EU member states (except for Cyprus and Malta), the eastern part of the Czech Republic, the Balkans, and the other countries in Eastern Europe.

The time span covered by the scenarios is 16 years, starting in 2005. On the one hand, this horizon seems short enough to relate a possible future state of affairs to today's world. On the other hand, 16 years seem long enough to also picture the yet undiscovered or, indeed, hardly imaginable.

In accordance with the methodological premises, the two scenarios address similar issues: the role of government and the economy, changes in social values, demographics, health and education systems, and technological changes. Furthermore, both scenarios are rather complex and include a number of variables. Both stress possibilities and opportunities but do not leave out risks and possible dangers. The reason for this is to avoid a simple black and white picture not corresponding to the complexity of the real world.

Life in 2020: Big Government Scenario Modest Society – Regulated Economy

In this scenario, big government, a slow-paced, modest society and a regulated market are the crucial pillars. According to this scenario, **big government, equal opportunities and individual freedom** will guarantee security. This will be underpinned by strong intermediary institutions, i.e., parties and interest groups. Even though some radical left-wing and nationalist parties will establish themselves, parties and party systems will support the state in performing its duties. At the same time, trade unions will adjust to these changes. In cooperation with industry associations, they will be pivotal in regulating work conditions. In addition, strong nation-states – at the national level and through international cooperation – will be able to mitigate crime and terrorism and guarantee security.

The most important changes will take place in the system of **social values**. Two aspects are crucial in this respect. Work will become less, leisure more important. In addition, individualism and competition will be replaced by **communitarian value**s and **solidarity**. More importantly, people will trade lower income for social values and a more relaxed social life. The kind of social responsibility accompanying this value shift will also be found at the international level, as the richer EU member states will support countries in Southern Europe.

Changes of values will be accompanied by an **altered age structure** of societies. The high proportion of elderly people will trigger economic changes, leading to new products and markets. At the same time, an infrastructure for lifelong learning must be set up, and the health care industry will take care of the needs of the elderly. Accordingly, the medical and health care sector will expand. But this will be partly organized on a private basis by neighbourhood health schemes, citizen self-help initiatives etc.

Structurally, the economies in the heartland of Europe will turn into **retail and service economies**, while the manufacturing industry will move to Eastern Europe. Legal regulations and strong political leadership will keep a check on the economy and the corporate sector. Like the society as a whole, the economy will commit itself to active social responsibilities and to community initiatives.

Labour markets will be more flexible, even though a high degree of regulation will still be in effect. Despite the fact that people will accept a **lower standard of living**, **decreasing incomes** and an i**ncreased tax burden**, it will be impossible for households to live on one income alone.

As far as environment is concerned, the state, the corporate sector and individuals will seek to conserve the environment and maintain a high-quality infrastructure. Overall, corporations, governments and private individuals will give long-term effects priority. Sustainability will be given precedence over short-term profits and considerations.

Life in 2020: Globalized Economy Scenario Lean Government – Venturesome Society

The markets and global competition in scenario 2 take over the role played by the government in scenario 1.

The **corporate sector** and the "laws" of the **global economy** are the driving forces in this scenario. Constraints on free market forces will largely be done away with, and government will avoid intervening in the advanced state of **globalized** markets. The **labour market is extremely flexible** and fluid in order to allow companies to adapt to changing market needs as quickly as possible. **Managing constant change** will leave no room for long-term strategies or non-economic considerations.

Politics and government will play an auxiliary or supporting role. Basically, they are to sustain the proper economic framework for business. **Lean government** and **weak nation-states**, however, will not be able to effectively fight terrorism or crime, giving private security services the opportunity to rise and spread. Also, political parties and trade unions will be weakened by their notorious inability to integrate an increasingly heterogeneous society.

Government will not have the resources to provide an infrastructure going beyond basic needs. That holds for education and health care as well as for unemployment and pensions. Society will be divided into those belonging and those who do not, into those who can afford and enjoy better and more expensive services, and those who cannot. This will divide society into two distinct classes: the haves and the have-nots.

Nonetheless, society will be generally willing to embrace change and take greater risks. People will enjoy the positive sides of individual liberty, the ability to shape one's life and thus achieve self-fulfilment.

Due to economic and social changes, traditional forms of social life (e.g., family, friends etc.) will be replaced by personal networks. These kinds of relationships offer greater variety but are less binding.

Communicative Scenarios Need a Dialogue Framework

Essentially, "Horizon 2020" lays out a choice between two options. We can either strive for "big government" (scenario 1) or for "markets and global competition" (scenario 2). Hence, "Horizons 2020" describes possible realms of action.

Concrete policy recommendations are not and cannot be part of "Horizon 2020". As the report did not include a precise forecast, specific policy recommendations would have contradicted the primary goal of "Horizons 2020", which was to trigger a debate with the public at large on the way we picture our future. The understanding that a scenario is not a roadmap to design a predetermined future gives politics, society, and the economy leeway to shape the future.

Nonetheless, the report has two major shortcomings. First, even though the content of the report has been discussed with executives from the Siemens Group represented in the advisory board, there is no indication whatsoever if and how the contents of the report have been disseminated and have become part of a public debate. The report does not show that actors, other than those with a mandate in the advisory board, have been approached. As a matter of fact, the report fails to address the question as to how this debate should be organized and who should participate in it. Consequently, the report might affect decisions of the Siemens Group, but will hardly leave any traces in public debate. Second, the report is not very specific about the way in which the scenarios might apply to the different regions. All in all, it seems that the scenarios presented provide exclusive options for Europe's economic heartland rather than for the four regions, which without doubt will experience very different changes. Hence, it might well be that Europe's heartland pursue the path towards scenario 1, while Eastern and Southern Europe strive towards scenario 2. Nonetheless, the report does not give any details on this issue.

Sources and References

- Horizons 2020. A thought-provoking look at the future. A study report of TNS Infratest Wirtschaftsforschung, Munich, at: http://w3.siemens.de/horizons2020/pdf/inhalt/presse/Horizons2020_szenarioreport_e.pdf
- www.tns-infratest.com

Démarche Prospective Transport 2050 – For a Better French Transport Policy

Authors:	Hugo Thenint, Louis Lengrand & Associés / hugo@ll-a.fr			
Sponsors:	French Ministry of transportation			
Type:	Covering the French situation while taking global challenges into account Field/sector: transport			
Organizer:	Conseil général des Ponts et Chaussées, Claude Gressier,President of the «Economics and Transportation» Unit			
Duration:	Dec. 2003 – Dec. 2005	Budget: NA	Time Horizon: 2050	Date of Brief : August 2007

Purpose

This foresight initiative intends to initiate the elaboration of a long-term strategic plan for French Transport policy. The exercise uses a French methodological approach to carry out retrospective analysis of historical trends and build quantitative scenarios. It provides general insights on transportation flows and opens public debate on public policies designed to prepare for the "post-oil" era and create impulses for a serious effort to reduce greenhouse emissions.

A Shared Long-term Vision of the Transportation System

"Démarche Prospective transport 2050" is a foresight initiative launched by the Conseil Général des Ponts et Chaussées (CGPC), a committee associated to the French Ministry for transportation. The CGPC organization comprises an «Economics and Transportation» Directorate, which is often requested to provide consultative input on projects with very long-term planning horizons.

At first, the CGPC carried out an audit between September 2002 and February 2003 on large-scale infrastructure programmes emphasizing the need for a better strategic assessment of existing and future transportation systems. Therefore, at the end of 2003, the CGPC decided to conduct a long-term

planning study on the transportation system in 2050.
The long-term horizon was chosen because of policy-making schedules in this field (15 to 20 years) and depreciation cycles of infrastructure facilities (30 years). By describing various future scenarios, this study intended to provide material for initial strategic discussion and debate amongst ministry officials and partners engaged in determining transportation policy.

Apart from the CGPC's staff, this planning exercise also involved a wide range of experts in the areas of demography, economics, transportation, energy and tourism, including representatives from various Transportation Ministry's offices (Direction de la Recherche et des Affaires scientifiques et techniques, etc.) as well as the INRETS Transport Research Institute and Futuribles International's think-tank.

An Iterative and Scientific Approach

The exercise uses a French methodological approach based on the development of quantitative models to carry out a retrospective analysis of historical trends and build four scenarios incorporating demographic, socio-economic, technical and environmental hypotheses.

The scenario-building work was performed from December 2003 through December 2005 in five iterative steps:

1. A retrospective assessment of transportation advances in order to determine a set of influential variables to be taken into consideration.
2. An elaboration of four prospective scenarios.
3. The quantification of the four scenarios by stipulating a range of possible values for both demand and supply variables for each one.
4. A quantitative estimation of the resulting transportation flows for each scenario using the hypothesis selected for demand and supply variables.
5. A compilation of analyses of the first key issues of transportation policy and conclusions for such policy.

The Futuribles think tank was commissioned to conduct the retrospective analysis of transportation over the past 30 years, as well as to identify system determinants and design the exploratory scenarios. A series of seminars was held in conjunction with the Futuribles working group.

All scenarios emphasize key structural trends (yet for the most part exclude potential crises and system failures) such as:

1. An average population of 67 million French residents in 2050 and the aging population.
2. France's economic growth averaging 1.5% annual GDP growth over the period 2002-2050 (1 to 2% range).
3. Alternative non-oil technologies providing between 8 and 50% of liquid fuels.
4. The price of a barrel of oil (including a carbon tax) or of alternative fuels varies between \$60 and \$180 across scenarios.
5. The price of electricity increases from 30 to 100% depending on the scenario.

	2002	Horizon 2050 scenarios			
		Scenario 1	Scenario 2	Scenario 3	Scenario 4
Demographic development (in millions)	59	67	58	67	70
GDP (annual growth)	2%	1.5%	1%	2%	1.5%
Price of a barrel oil	28\$	30\$	60\$	60\$	120\$
Carbon tax	0	60\$	0	30\$	60\$
Land-based passengers	100 (base)	150	118	164	158
Airline passengers	100 (base)	191	185	318	168
Freight volume	100 (base)	167	94-117	146-182	150

Prices shown in US\$

Meeting Transport and Energy Future Challenges with Realistic Predictions

The four potential worldwide and European geopolitical outlooks serving as input to the four quantitative scenarios were:

- **Scenario 1 «Worldwide governance and environment-friendly industry»** is characterised by worldwide cooperation for enhanced control over energy-production technologies and pan-European policy, favouring industrial development that alleviates adverse effects of greenhouse gas emissions.
- **Scenario 2 - «European isolationism and decline»** anticipates ferocious economic competition in the context of an energy supply crisis; each European nation manages and protects its resources, and both demographic and economic growth rates remain low.
- **Scenario 3 - «A tightly-integrated, enlarged Europe»** encompasses the successful economic integration of the Mediterranean Region and Russia into the European Union, providing economic development and European security.
- **Scenario 4 - «Inward-looking European governance and regionalization»** anticipates a worldwide energy crisis, in which Europe pursues an endogenous growth strategy, emphasizing integration but restricting open-door policy.

Limited Growth in Future Transportation Flows with Contrasting Trends for Freight Flows

Each scenario lays out a different future course, with economic growth being more robust in Scenario 3. Moderate transportation increases, compared to the past 30 years, represent the most obvious future trend.

The first observation is that the demand increases for passenger transportation can be expected to slow down on global scale. Main reasons are:

- A marginal rise of the household rate of automobile ownership.
- The stability of travel speeds due to network operations, safety or environmental considerations.
- The increase of transportation prices because of stricter environmental and safety rules, as well as the rising cost of energy.

Because of slowing French population growth and expansion of remote access services such as e-administration, e-commerce or telemedicine, the softening in demand will be particularly significant in day-to-day local mobility (in the range of 10 to 40% over the period 2000-2050).

With the exception of Scenario 2, on the other hand, long-distance passenger flows could double over the period as a result of slower household income growth. Although the increase will benefit from the road network, gains in public transportation will rise, particularly for high-speed rail (+100-200%).

Regarding international airline travel, an increase between 100 and 320% at all French airports is foreseeable (compared with 156% during the 1986-2000 period). Limited growth would be due to the level of congestion already reached for domestic airline travel, the competition with trans-European high-speed rails and the impact of oil price hikes on air transportation costs (especially in scenario 4).

Freight transportation development will be structurally tied to industrial trade patterns at national and European levels. Differences between scenarios depend on the type of growth envisaged (favouring industry vs. the tertiary sector):

- Scenario 1 reflects a slowing in the expansion of intra-European flows and a strong increase in international flows such as container traffic.
- According to Scenario 2, domestic transportation will drop beyond 2025 and settle at a level just slightly higher than the situation in 2002.
- Scenario 3 will result in a strong global growth in freight flows, along with a concentration on major land transit corridors and Mediterranean ports.
- In scenario 4, national transportation volumes will experience stronger growth, but trading and transit traffic, along with container shipments, will increase at a slower rate than in either of these two other scenarios.

Traffic Flow Concentration: Bottlenecks on the 2050 Horizon

From the angle of limited growth in travelling under all scenarios and given a 2050 horizon year, the risks of network congestion remain contained and visible.

Within interurban areas, France's average road network load factor will stay at a manageable level, especially in comparison with networks in Germany and the Benelux countries. This global forecast in local mobility must not obscure distinct regional disparities in demographic development (from -20% to +25%) and their impact on transportation.

Some major metropolitan areas, such as Marseille, Nice-Riviera Coast, Nîmes-Montpellier and Toulouse, will face strong real estate pressure and increasing operational difficulties. On the other hand, metropolitan areas located in regions with projected demographic drops could face obstacles in managing their public transportation services.

The risks of congestion will mostly be concentrated along suburban thoroughfares and on a small number of network bottlenecks. Traffic will be concentrated on major transit corridors or amass at popular tourist destinations.

Regarding the Rhone corridor, scenarios calling for an average growth in European GDP predict a doubling in passenger traffic between 2000 and 2050 on the road network and, depending on the hypotheses adopted, a rise in freight traffic by 50% to 100%.

Scenarios for the Atlantic seaboard forecast a doubling in passenger traffic and an increase by 50 to 150% in freight, depending on growth prospects affecting the Iberian Peninsula and its international trading patterns.

Consequences for Transport Modes Development and Energy Consumption

While all scenarios indicate a favourable modal shift - travel speeds, fuel prices, taxes, automobile limitation policies within high-density zones, etc. – roads will, in any case, remain the dominant channels of transportation. Regarding fuel price, a 50% rise in the energy cost of a vehicle-km in scenario 2 would induce a net drop of just 6.4% per vehicle-km.

Even if an increase in rail and waterway freight traffic induces sizable local effects along major bulk corridors, these effects will not significantly influence overall flows. In Scenario 3, for example, a large jump in rail and waterway traffic would only lower the share of road trips in 2050 by 4.5%. The stagnation or relative dip in energy products and raw and intermediate goods making up the traditional core of freight transported by rail and waterway will tend to consolidate the modal share of road transportation.

For this reason, large-scale modal shifts allowing a drastic shift in energy consumption and greenhouse gas emissions are hardly conceivable. Accordingly, it is necessary to simultaneously improve energy efficiency and reduce greenhouse missions associated with road transportation.

When considering ambitious road transportation improvements, some scenarios do forecast sizable reduction in road-generated CO_2 emission. For example, in scenario 1, CO_2 emissions from transportation could be reduced by a factor of about 2.5 by 2050, compared with year 2000 values. This is owing to passenger vehicles with an average consumption efficiency of 3 litres per 100 km, one third fuelled by biomass and another third by electricity.

Need for Multi-layered Governance & Political Cooperation

Although this foresight project was not carried out in view of drawing up policy recommendations, the project team did contribute to the formulation of a framework for building public-sector action plans.

Preparing for the Post-oil Era and Taking a Serious Stand against Greenhouse Emissions

Technological breakthroughs necessary to achieve emissions reduction require a decisive step forward in worldwide governance or, at the very least, in consolidated European governance.

- **Assign clear priority to research & development activities.** In this field, developing policies on a European scale is more promising than on a national one. Specific target fields would include rechargeable hybrid vehicles, carbon-free electricity production and synthetic fuels stemming from biomass.

- **More ambitious standard-setting actions**.
  Breakthroughs shall be instigated by regulatory measures. Because of its longstanding experience with the technical aspects of vehicle regulations, the European Union can establish a set of objectives and rules for the automobile industry, such as energy-consumption standards on vehicles or fuels (minimum percentage of «clean» fuels), taxes or permitting tradeoffs, etc.

- **Filling the worldwide governance gap to deal with the greenhouse effect.** A European policy on fuel-efficient vehicles and clean fuels will only be truly effective if it is adopted and relayed across the world. Hence, the development of new energy systems must be supported by globally applied economic instruments, such as negotiable emissions permits or a tax on carbon.

Handling Bottlenecks within Infrastructure Networks

In order to tackle future traffic and transport operations, the project team strongly recommends conducting more focused studies and measurements over the Atlantic seaboard and the Rhone corridor in conjunction with a large-scale infrastructure projects approved by the government in 2003.

The next stage will extend this planning approach by involving appropriate administrative agencies and service operators to enhance transportation supply and demand forecasts on the basis of the four scenarios.

These organisations shall cooperate closely with local actors and public authorities to establish and adopt key planning documents or hold public hearings.

Besides, improving major trans-European routes will only be possible if neighbouring public authorities cooperate closely. To this end, «Rhone Valley and Languedoc Mediterranean rim transportation policy» constitutes a very useful initiative.

Sources and References

Transport 2050 final report: **http://www.equipement.gouv.fr/IMG/pdf/report_cle1db135.pdf**

Futuribles Think-Tank report: **http://www.equipement.gouv.fr/IMG/pdf/prosp.tr.2050_-_rapport_vljuin.05_cleoefd4b.pdf**

FAZIT – The Future of ICT in Baden-Württemberg

Authors:	Kerstin Cuhls / Kerstin.Cuhls@isi.fraunhofer.de			
Sponsors:	State Ministry of the Federal German State of Baden-Württemberg			
Type:	Regional foresight activity concerning international topics			
Organizer:	MFG Stiftung (Foundation for Media and Film) Baden-Württemberg, Stuttgart, as coordinating organization, the Centre for European Economic Research (ZEW), Mannheim, and the Fraunhofer Institute for Systems and Innovation Research (ISI), Karlsruhe, as partners.			
Duration:	2005-2008	Budget: Total € 3 million, € 900 k for the foresight part	Time Horizon: Until 2020	Date of Brief: Sept. 2007

Purpose

In FAZIT (research project for current and future-oriented information and media technology and its use in Baden-Württemberg), present and future demand and applications for innovative information, communication and media technologies are being explored. The objective is to identify key drivers for new markets and innovations in the ICT sector in Baden-Württemberg, Germany, which are important for further regional development. The different activities are intended to bring together actors in a regional innovation system, both from the ICT sector and traditional industries. A final roadmap for «new markets in the ICT sector in Baden-Württemberg» is intended to integrate the milestones, which can be strategically used by State decision-makers.

How Can Foresight Contribute to STI?

How can research on science, technology and innovation (STI) contribute in guiding practical policy? An ongoing foresight exercise in Baden-Württemberg, Germany, called FAZIT is one of the processes intending to answer this question.

What is FAZIT?

The theoretical framework of the non-profit research project is the regional systems of innovation approach. Innovations are an evolutionary and cumulative process with internal feedback loops, which can only be realised by relevant regional actors interacting economically and socially (Koschatzky, 2005). Results from this process are technological, organisational and social innovations. This underlines the significance of social aspects in the innovation process, especially through collective learning processes and integration of the different actors in the region.

Combination of Delphi Surveys, Scenarios and Roadmap

Fraunhofer ISI is conducting a multi-stage foresight process in order to identify relevant fields of research and future developments in the field of ICT and media technologies that are vital for the region of Baden-Württemberg. As technological, social and economic trends closely interact with each other, a combination of foresight methods is being applied. The foresight process consists of three Delphi studies, a scenario process and a roadmap for future ICT developments. Each phase of the foresight process is closely linked with ongoing ICT monitoring and the results of studies on market issues.

In a first step, Fraunhofer ISI is carrying out three **Delphi** studies. Each of the three Delphi surveys involves about 500 to 1,100 regional, national and international German-speaking experts from business, science and society. The first Delphi study dealt with social aspects of ICT adoption and implications of the innovations. The second Delphi survey is about ICT & Health, and the last will deal with

technological developments in other related fields.
The third Delphi survey was directly derived from the FAZIT **scenario** process. On the basis of a scenario workshop, topics were formulated and were assessed in a two-round Delphi survey. The Delphi results will be included in the final FAZIT scenario on science and technology. Thus, a two-fold integration of the results is intended.

The scenario process aims at generating a multi-dimensional picture of new markets arising through ICT in Baden-Württemberg. For the duration of the project content will be continuously supplemented. It is of vital importance to the scenario process in FAZIT that the following questions are addressed: How will the field of IT and media in Baden-Württemberg develop by the year 2020? Which issues and areas are of particular significance, which traditional industries will be particularly affected by developments in ICT, and how does the situation in Baden-Württemberg differ from those in other regions? It becomes necessary to link the results from the Delphi survey and from the market studies with the actual scenarios, as one step in the scenario process is the conception of alternative paths for future developments. In addition, successive (partial) scenarios might be generated.

At the end of the foresight activity, a **roadmap** extending to 2020 will be drawn up for the ICT industry in Baden-Württemberg. Road-mapping is a way of bridging the gap between today and the scenarios or images of the future. They are close to planning and define the first steps or even targets on the way to the imagined future (Cuhls/ Möhrle, 2004; Möhrle/ Isenmann, 2004). Vitally important to this is the identification of milestones and critical bottleneck factors which require urgent action and which raise questions for further research. The results of the previous foresight modules will be summarised and integrated into the roadmap.

User Acceptance as a Major Issue

The methodological challenge of the first Delphi survey consisted in integrating technical and social questions. Notably, the design of the topics, statements and «questions» (criteria to be judged upon) were adapted in a way that the results can be integrated into and used during the scenario creation process. They were not directly derived from the scenario process but developed separately.

The survey was conducted online and in two rounds including feedback. What was new was that the questions covered social and demand-side aspects with regard to general trends, such as the demographic development in Baden-Württemberg, rather then being based on technological or research assumptions. As a result, user acceptance of the different technologies was often discussed as a major issue.

The most feasible topics were the following:

- Due to widespread virtual co-operation within enterprises and corresponding organizational forms, people can work more efficiently, innovatively and creatively in many areas (e.g., R&D, marketing).
- Very good IT skills are necessary for more and even simple jobs. This means that workers without IT skills will be forced out of the job market.
- Biometrical access controls to public buildings and workplaces are generally accepted.
- Besides preventing and combating crime, permanent surveillance of public places also serves to pursue the infringement of regulations.
- In social sciences and humanities more than half students also make use of virtual reality simulations at least once a semester.
- More than half of drivers accept that their vehicles pass on anonymized information about themselves as well as local traffic and street conditions to other vehicles in order to receive such information in return.

The second Delphi survey was intended to be a technical Delphi, i.e., dealing with technical questions of high relevance for Baden-Württemberg. ICT developments can contribute to meeting Baden-Württemberg's challenges of demographic change as well as changes in the health care system. Literature research was the starting point. Then a structure of applications on the one hand and technologies on the other (visualized in a mind map) was developed as input for an expert workshop. Here, technical and other experts (e.g., from a health insurance provider, an association and physicists) discussed the needs of the health system and formulated first Delphi topics.

An online Delphi questionnaire was developed and sent to more than 1,000 experts from academia, industry, doctors and their associations as well as research organisations. In the second round, feedback was given (aggregated answers from the first round) so that the experts could assess the topics. The results of the second round were the end results for further use in the following scenario processes.

One first result here was that it is not a specific technology, but rather the question of the **system itself** which is crucial in preparing for the future. Furthermore, developments in specific areas were rated according to three criteria: as extremely important for the quality of life, as desirable, as developments that will definitely be realised in the short- to medium-term.

New Markets for ICT

New markets for IT-based health services are expected in the fields of **language recognition, virtual reality, simulations, databases, sensors, radio frequency identification** (RFID) and **new management and planning systems**. It makes a significant difference if the technology as such is only applicable in the health sector or can be used in other sectors as well. The **health sector** is a large market, but often not large enough for such a new development and its market penetration. In detail, a market seems to be realistic in the following areas:

- **sensors** for measuring long-term **blood pressure**;
- **RFID in houses** for people who are forgetful and need to find their way back or find things via RFID tags;
- **expert systems and databases** which test **drug combinations** for undesirable side-effects and which propose alternative therapies without these potentially harmful interactions and side effects;
- **patients in hospitals** being controled by ICT systems to avoid extended waiting times for admission, for surgery, X-ray examinations, etc, allowing hospitals to work more efficiently;
- an ICT system for **mobile doctors** so that they can access all their patients' data;
- **regional microwave hyperthermia** can be optimally planned by computer simulation of **body heat distribution;**
- **virtual reality** becoming standard practice in the **education** of medical specialists (virtual surgeries, minimal-invasive interventions, endoscopic examinations, patient dialogues);
- **documentation** in a hospital handled entirely by **speech recognition.**

The topics concerning **robots in healthcare and in surgery** are more critically assessed, e.g., «In many hospitals, robots are used for heavy and standardised jobs in care, in order to give personnel more time for the personal care of patients». The experts think that they are feasible and will be realised – however, they do not want them (high rate of "unwanted").

ICT Impacting Traditional Industries

In addition to the foresight exercises, market studies are being conducted to investigate the impact of ICT developments on traditional industries in the region:

- market potential for IT-supported health services;
- potential for flexibilisation via e-businesses;
- market potential for social software;
- ecological efficiency increase via IT;
- IT and intralogistics;
- visualization and simulation in product development.

The market studies review the potential for the use of ICT for different regions or technology clusters in Baden-Württemberg and identify capabilities on a regional level. They are therefore suitable for policy-makers on different levels, from the local and regional to the federal level. They indicate possible directions of future innovations and markets and complement the data on the future of Baden-Württemberg.

Scenario Planning

Different scenarios for Baden-Württemberg are being drawn up. The first one is a "baseline scenario". In this scenario, the structural data of the German Federal State and trends for the future are described. A storyline based on this data illustrates the scenario.

Additionally, more detailed "in-depth" scenarios in different IT-related fields are being outlined. One of these will be a technology scenario. For this, the data generated by the second Delphi survey will be used and included in the description and the story. The statements made in the survey as well as the estimated time of realisation will be the major sources of input to base the scenario on. The scenarios will be completed in autumn 2007.

Dissemination Directly to Society

The results of the ongoing activities are available as reports. A symposium on ICT use by older people was held as a follow-up to the first Delphi survey and the market study on IT-supported health services. Meanwhile, more than 30 presentations of the project have been held at international and national conferences and seminars. 25 papers have been published.

Other implementation activities are:

- the support of regional innovation systems via company software through the transfer of relevant results for the clusters;
- implementation of relevant special trends in existing clusters and networks (Kreatek – another MFG Foundation project);
- further development of trends in social software and social media (visual computing);
- transfer in trend studies and impacts for medium-sized companies (Web 2.0);
- direct transfer of future trends from the studies to research institutions for software development and IT trends (ebigo.de);

- transfer of trend studies and their implications for relevant web sites (Software Research Day);
- adaptation of technology transfer to relevant future areas (doit-online/mfg-innovation – other MFG Foundation projects).

Decision-makers from companies and organizations can make use of the information for their own purposes. FAZIT serves mainly as information input for them and for anybody else wanting to know about the future of IT in Baden-Württemberg – an ultimately all over the world as this is an international topic.

Super-regional Implications

FAZIT is a regional initiative but deals with international topics in the ICT sector. Therefore, the results generated by the future-oriented part of the project are not only relevant for the Baden-Württemberg audience, but also for international players in the game.

Sources and References

Available results (primarily in German).

- Von Oertzen, Jürgen, Cuhls, Kerstin, Kimpeler, Simone: Wie nutzen wir Informations- und Kommunikationstechnologien im Jahr 2020? Ergebnisse einer Delphi-Befragung, FAZIT-Schriftenreihe, Band 3, Stuttgart 2006, **www.fazit-forschung.de**
- Cuhls, Kerstin; von Oertzen, Jürgen und Kimpeler, Simone: Informationstechnologie und Gesundheit. Ergebnisse einer Delphi-Befragung, FAZIT-Schriftenreihe, Stuttgart 2007, **www.fazit-forschung.de**
- Cuhls, Kerstin und Möhrle, Martin G.: Unternehmensstrategische Auswertung der Delphi-Berichte. in: Möhrle, Martin G. and Isenmann, Ralf (eds.): Technologie-Roadmapping, Zukunftsstrategien für Technologieunternehmen, 2nd edition, Springer, Berlin 2004, S. 103-130
- Martin G. and Isenmann, Ralf (eds.): Technologie-Roadmapping, Zukunftsstrategien für Technologie unternehmen, 2nd edition, Springer, Berlin 2004
- Koschatzky, Knut: Foresight as a Governance Concept at the Interface between Global Challenges and Regional Innovation Potentials. In: European Planning Studies 13 (2005), 4, S. 619-639
- Kimpeler, Simone; Döbler, Thomas: The Future of IT and Media Technologies and their Use in Baden-Württemberg: Fazit - A Multi-Method Approach of Monitoring and Foresight. In: Companó, Ramón (Ed.) u.a.: IST at the Service of a Changing Europe by 2020: Learning from World Views: FISTERA Final Conference, Bucharest: Publishing House of the Romanian Academy, 2005, S. 122-131
- Publications available at: **www.fazit-forschung.de**

The Singularity Scenario

Authors:	René Mittringer / rene.mittringer@arcs.ac.at
Sponsors:	Austrian Research Centers GmbH – ARC Systems Research
Type:	Single issue, future technology study
Organizer:	NA
Duration:	ongoing | Budget: NA | Time Horizon: Until 2050 | Date of Brief: Sept. 2007

Purpose

Although the term 'Singularity' or 'Technological singularity' has already infatuated both the scientific and the science fiction community alike throughout the 20th century, there is reason enough to report about the ongoing activities in this area. So far it is possible to distinguish between Artificial Intelligence (AI) and related issues and the prospective fusion of emerging technologies such as nano-, bio-, information and cognitive technologies (NBIC) – also referred to as converging technologies. It is assumed that there will be an immense technological and consequently economic shift once those technologies surpass the boundaries of human intelligence in the 21st century.

The Future Will be Different

In 1958, Stanilslaw Ulam, referring to a meeting with John von Neumann, wrote:

"One conversation centered on the ever accelerating process of technology and changes in the mode of human life, which gives the appearance of approaching some essential singularity in the history of the race beyond which human affairs, as we know, could not continue."

The rapidity of technological change (see Moore 1965; Kurweil 1999) in recent times fuels the expectation that continued technological innovation will have a large impact on humanity in the decades ahead. No matter whether it will be the creation of self-improving artificial intelligence, as first stated in 1965 by I.J. Good, some "superhuman intelligence" (Vinge 1993), or the transfer of the human mind into a computer with the help of emerging technologies, these prospects will merit serious attention:

"(...)Virtual reality; preimplantion genetic diagnosis; genetic engineering; pharmaceuticals that improve memory, concentration, wakefulness, and mood; performance enhancing-drugs; cosmetic surgery; sex change operations; prosthetics; anti-aging medicine; closer human-computer-interfaces: these technologies are already available or can be expected within the next few decades. The combination of these technological capabilities, as they mature, could profoundly transform the human condition." (Bostrom 2005)

As a matter of fact, predicting that a single event will lead to change turning humanity upside down may seem far-fetched. Notwithstanding, we must concede that we are evidencing developments indicating transformative change. Whether this will indeed lead to 'singularity' as a period of growth, to crossing the borderline to 'transhumanism', or to the start of a new epoch is a question not to be answered here.

The following three core topics – according to Kurzweil's book 'The singularity is near' (2005) – were chosen in order to support a feasible 'Singularity Scenario', representing the progress of science and technology to be expected within the coming decades:

- genetics,
- nanotechnology,
- robotics.

Genetics - Intersection of Information and Biology

Will we control aging and personal health with the help of genetics? Here are some promising innovations and developments in this field:

- **RNAi (RNA Inferference)**
- Means being capable of turning off specific genes by blocking their mRNA and preventing them from further producing proteins (important for the life cycle of viral diseases, cancer and many other diseases).
- **Cell therapies**
  Regrowing our own cells and introducing them into our body without surgery; "therapeutic cloning".

- **Gene chips**
  Genetic profiling relevant to drug screening and identification, improving cancer classifications, identifying undesired pathways, genes and cells, and determining the effectiveness of an innovative therapy.
- **Somatic gene therapy**
  Gene therapy for nonreproductive cells by effectively changing genes within the nucleus; creating 'new genes'.

Reversing Degenerative Disease

Degenerative (progressive) diseases – heart disease, stroke, cancer, type 2 diabetes, liver disease and kidney disease – account for about 90 percent of deaths in our society. Strategies have been identified to halt or even reverse the underlying processes in each case:

- **Combating heart disease**
  Regrowing our own cells or even organs and introduce them into our body without surgery; "therapeutic cloning".
- **Overcoming cancer**
  The design of cancer vaccines to stimulate the immune system to attack cancer cells seems promising.

Reversing Aging

Key factors of the aging process and reversing strategies:

- **DNA mutations**
  Using gene therapy in order to remove those genes from our cells that cancers rely on to maintain their telomeres in dividing.
- **Toxic cells**
  Methods are being developed to programme "suicide genes" to attack fat cells or "old" cells enabling the immune system to destroy them.
- **Mitochondrial mutations**
  Transferring mitochondrial genes into the nucleus of cell structures to provide a backup for efficient functioning.
- **Intracellular aggregates**
  Strategies using gene therapy to introduce new genes to break down so called 'intracellular aggregates' – toxins within cells.
- **Extracellular aggregates**
  AGEs (advanced glycation end-products) result from undesireable cross-linking of useful molecules as a side effect of excess sugar. These cross-links interfere with the normal functioning of proteins and are key contributors to the aging process. Experimental drugs like ALT-711 (phenacyldimenthylthiazolium chloride) can dissolve these cross-links without damaging the original tissue (S.Vasan, P.Foiles, H.Founds 2003; D.A. Kass 2003). Other molecules with this capability have also been identified.
- **Cell loss and atrophy**
  A hybrid scenario involving both bio- and nanotechnology contemplates turning biological cells into computers. These "enhanced intelligence" cells can detect and destroy cancer cells and pathogens or even regrow body parts. Scientists at the MIT Media Lab for instance have developed ways of using wireless communication to send messages, including intricate sequences of instructions, to the computers inside modified cells.

(Human) Cloning

Cloning will be a key technology – not for cloning actual humans (which will probably not be avoidable sometime in the future irrespective of reasonable ethic reservations), but for life extension purposes, in form of 'therapeutic cloning' as mentioned above. Furthermore, cloning will be important for preserving endangered species and restoring extinct ones, for pharmaceutical production (milk of transgenic goats) and human somatic-cell engineering. The latter allows to bypass the controversy of using fetal stem cells by transdifferentiation: by manipulating proteins or rather understanding their RNA fragments and peptides, gene expression can be controlled. Perfecting this technology will also defuse the ethical and political explosiveness of this issue.

Nanotechnology - Intersection of Information and the Physical World

"The principles of physics, as far I can see, do not speak against the possibility of maneuvering things atom by atom." (Feynman 1959)

Along with the progress of full-scale nanotechnology, there will be potential to replace biology's genetic-information repository in the cell nucleus. A nanoengineered system would maintain the genetic code and simulate the actions of RNA, the ribosome, and other elements of the computer in biology's assembler. A nanocomputer would maintain the genetic code and implement the gene-expression algorithms. A nanobot (a small robot) would then construct the amino-acid sequences for the expressed genes. Such a nanoengineered system would allow turning off unwanted replication and thereby defeating cancer, autoimmune reactions and other disease processes. Nanobots in the bloodstream are another example. Seemingly futuristic, many such micro-scale devices are already functional in animals.

Apart from replicating biological molecular-assembly capabilities, molecular manufacturing pursues another goal: to improve computation. The switching speed of nanotube-based computation would greatly exceed the speed of electromechanical switching. Furthermore, there

is tangible progress in the actual construction of molecular machines.
Another focus will be on the development of clean, renewable, decentralised and safe energy technologies made possible by nanotechnology and, on the other hand, to use nanotechnology to increase energy efficiency, e.g., basic energy transmission, wireless transmission of energy by microwaves, for hydrogen fuel-cell powered cars or solar power (see also: The Millennium Project of the American Council for the United Nations University, 2004 report of the U.S. Department of Energy).

Promising as well is the creation of new manufacturing and processing technologies that will dramatically reduce undesirable emissions.

Robotics: Strong AI

The third topic, or rather revolution, in the GNR bundle is Robotics or strong artificial intelligence (strong AI). It shows parallels to the human duality of body and mind. However, the core aim is to create artificial intelligence exceeding human intelligence and robotics would be its embodiment.

Another key question is whether strong AI will lead to full nanotechnology (molecular-manufacturing assemblers that can turn information into physical products), or will full nanotechnology lead to strong AI; whereas the first scenario could help solve remaining design problems of enhanced nanotechnology, the latter indicates the so far insufficient hardware applications for strong AI.

There are already several simple forms of AI techniques available such as character recognition, speech recognition, machine vision, robotics, data mining, medical informatics and automated investing, but the essential barrier to strong AI is developing sufficiently detailed models of how human brain regions work in order to design AI properly (reverse engineering of the human brain or natural intelligence). Machine intelligence might be good in consistently performing peak levels and skills or in pooling resources, but it is still pretty weak on parallel pattern recognition. Without any doubt, a task humans are still far better capable of performing.

Approaches or tools usually considered to overcome this shortcoming are:
- expert systems,
- Bayesian nets,
- Markov models,
- neural nets,
- genetic algorithms (GA),
- recursive search and
- combining methods.

Fields where "narrow forms" of AI are already showing considerable progress are:
- **Military intelligence**
  U.S. military intelligence uses pattern-recognition software systems to guide autonomous weapons, and unmanned robotic flying fighters were used in the 2003 Iraq war.
- **Space exploration**
  The Deep Space One Mission in 1999 used AI-based systems capable of reasoning through new situations rather than just following pre-programmed rules. Another NASA AI system called Moving Object and Transient Event Search System (MOTESS) learned on its own to distinguish stars from galaxies with an accuracy surpassing that of human astronomers. Similar systems are obviously found again in military applications for detecting spy satellites or the like.
- **Medicine**
  Applications in medicine are in automated ECG analysis tools, intelligent data mining and pattern recognition for the development of new drug therapies, detection of diseases and development of therapies, or complex expert systems for differential diagnosis; e.g., evaluating possible allergies caused by drug interactions.
- **Science and math**
  Applications in this area are AI based systems capable of formulating theories, robotic systems that can automatically carry out experiments and finally a reasoning engine that evaluates results.
- **Business, finance and manufacturing**
  AI systems are used to control and optimise logistics (e.g., Wal-Mart, Ascent Technology's SAOC system), detect fraud and money laundering (NASDAQ's SONAR system), and perform intelligent data mining.
- **Manufacturing and robotics**
  Computer-integrated manufacturing (CIM) uses AI techniques to optimise the use of resources, streamline logistics and reduce inventories by just-in-time purchasing of parts and supplies. The newest trend here is to use "case-based reasoning" rather than hard-coded, rule based expert systems.
  Robots are extensively used in manufacturing and they in the meantime use AI-based machine-vision systems enabling autonomous interaction and navigation. Consequently, military use is also in the line of this development.
- **Speech and language**
  Probably one of the biggest challenges to AI is to cope with natural language. Google and other search engines use AI-based statistical learning methods and logical inference to determine the ranking of links. The real barrier for such search engines is inability to understand the context of words. Microsoft has developed a natural-language search engine called Ask MSR (Microsoft Research) to answer natural-language questions. And at least 75 percent of the time the correct answer is among the top three ranked positions.

Computer language translation, for instance, also continues to improve gradually, but it will be one of the last application areas to fully compete with human capacities.

Already more advanced are so-called virtual agents capable of appropriately responding (usually via phone or equivalent services) to an asking counterpart. Companies such as British Airways and Verizon use these systems for customer services while Charles Schwab and Merrill Lynch use them to conduct financial transactions.

The various examples in the section above show that the performance of AI is continually progressing and expanding, while the range of tasks in which machines compete with human intelligence is growing larger and larger.

Conclusio without Ultima Ratio

Considering policy issues, the task is to develop appropriate measures such **as legal and ethical standards**. Certainly, it will be a trade off between technological progress and balancing the risks for human society that policy makers have to keep in mind. However, regardless of the measures taken, regulation, as a matter of fact, will be busy just trying to keep pace with fast-moving technological progress. Far from being able to control this development, government has to prepare at least a 'best response' to speak in terms of game theory. In light of these challenges to traditional conceptions of self-regulatory evolution of human kind, the singularity assumptions proposed in this brief will require rigorous measures and defensive steps to avoid undesirable and even sometimes inevitable risks of progress.

Sources and References:

Bostrom, N. (2005): A History of Transhumanist Thought, Journal of Evolution and Technology, Vol. 14 (1). http://www.jetpress.org/

Feynman, R. P. (1959): There's Plenty of Room at the Bottom, American Physical Society annual meeting, Pasadena, CA.

Kurzweil, R. (1999): The Age of Spiritual Machines: When computers exceed human intelligence, Viking Pub., N.Y.

Kurzweil, R. (2005): The singularity is near, when humans transcend biology, Penguin Books, N.Y.

Moore, G. E. (1965): Cramming more components onto integrated circuits, Electronics, Vol. 38 (8). http://download.intel.com/research/silicon/moorespaper.pdf

Moravec, H. (1998): When will computer hardware match the human brain?, Journal of Evolution and Technology, Vol. 1 (1). http://www.jetpress.org

Vinge, V. (1993): Technological Singularity, VISION-21 Symposium, March 30-21. http://www-rohan.sdsu.edu/faculty/vinge/misc/WER2.html

SMART Perspectives of European Materials Research

Authors:	Show-Ling Lee-Müller, s.l.lee-mueller@fz-juelich.de; Agnes Pechmann, pechmann@dialogik-expert.de; Pavol Sajgalik, uachsajg@savba.sk; Gerd Schumacher, g.schumacher@fz-juelich.de			
Sponsors:	European Commission			
Type:	European foresight on materials research			
Organizer:	Schumacher, Gerd, Project Management Juelich, Germany, Coordinator			
Duration:	04/2005-03/2007	Budget: € 480 000	Time Horizon: 5-15 years	Date of Brief Aug. 2007

Purpose

Modern materials sciences take as their objective to develop and tailor materials with a desired set of properties suitable for a given application. Next to conventional approaches, predictive modelling and simulation is more and more used. This results into a rapidly increasing knowledge base, allowing for more precise experimental set-ups, more precise simulations and tailoring of goal-oriented materials. They play a key role in the value chain and in product innovation. Although limited profits are made from materials, materials are technology enablers for new high added value products and therefore a key in innovation acceleration. More success and increased opportunities for applications is the outcome. The SMART project aimed at providing support for future strategic decisions in this sector to foster the strengthening of the European Research Area.

Which Future?

SMART is a Specific Support Action within the 6th European Framework Programme, which aimed at mapping of future materials research topics and excellent research groups throughout Europe. Data screening, interviewing and the workshops in the SMART project have shown that Europe has a strong and internationally competitive position in materials research. However, even though materials technology is in a good position today, some weaknesses of the European mate¬rials innovation system identified in the SMART could become a risk in the future, if no action is taken.
Forecast and Foresight

A parallel concept is at the core of the SMART-strategy in which both a traditional forecast and an innovative foresight are applied - see Figure 1. The SMART process can be divided into several stages. The first stage involved data screening on the forecast side and identification of relevant studies on the foresight side. In the second stage expert interviews and analysis of studies led to further progress. In the third and final stage the roadmapping exercises combined both the forecast and foresight results by three thematic workshops.

Socio-economic Topics and 'Technical Pillars'

Industrial Sectors are Dependent on High-tech Materials

Materials innovations are an important part of the cultural European heritage. This can best be seen at the typical European Design. Today, competitiveness on materials innovation is still of utmost important for the following industrial sectors:

- Automotive industry
- Aerospace industry
- Chemical industry
- Electronics
- Textile industry
- Energy technology
- Medical technologies
- Construction
- Defense & security

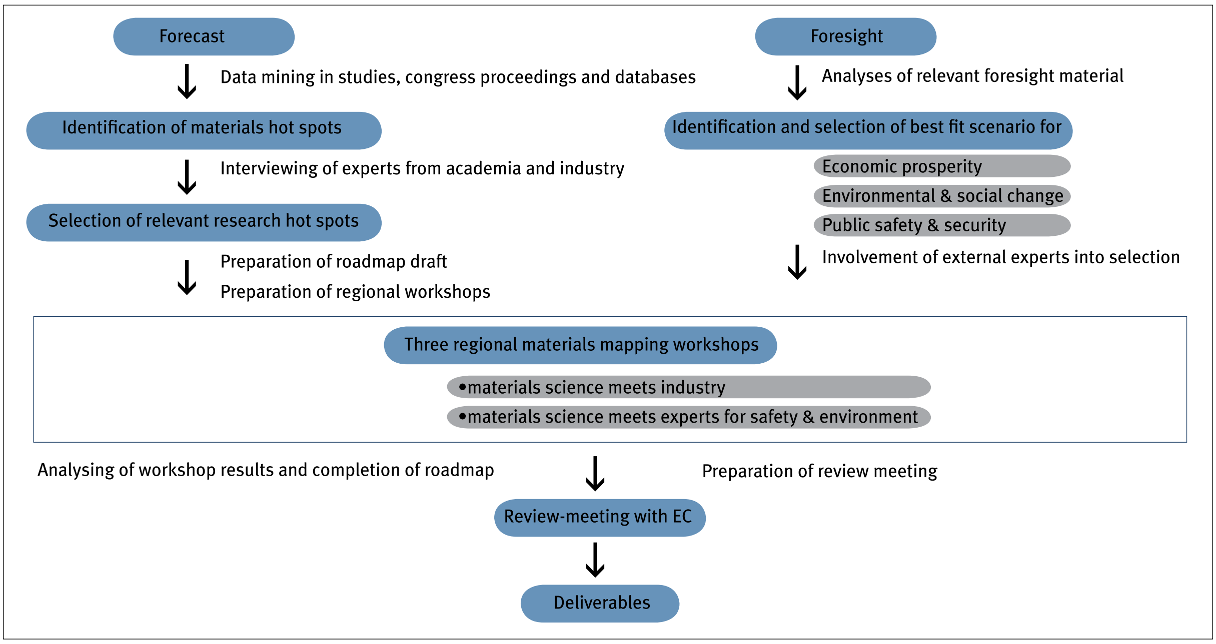


Fig. 1 SMART process

During the course of stage one, 40 foresight studies were evaluated regarding the most important general topics in politics and society and most mentioned material hot spots. There have been three roadmaps completed in the SMART exercise. For details please turn to the Final Report of SMART or the SMART website - see Source and Link section below. From these completed roadmaps there are three socio-economic areas where new materials will have a market effect: energy, safety and security, and better life including healthcare. They will be highly impacted by the three material topics: Sensors, modelling capabilities and nanotechnology.

Energy

Production, use, conservation and management of energy across Europe are top priorities for the future economy. Improved communication across the different energy producing sectors is called for since they all have similar problems. Another issue is the search for potential routes to zero carbon dioxide energy generation through solar technologies and fusion techniques.

Energy conservation for housing will benefit from developments in nanotechnology, for example, with sensors and novel coatings to minimize energy loss and store energy that is generated by individual houses.

Security

There is an increasing requirement for security in public infrastructures, buildings and communications, which will give raise to innovative security and safety technologies like sensors and sensing materials. Materials developments will play a major role in both personal protection and proof of identity. For the future progress in the security use of RFIDs, the further developments of advanced polymers for printed electronics are needed.

Quality of Life

The enhancement of quality of life of Europeans is an ever-continuing challenge. Employment, ageing, health and the participation of disabled people in everyday life are only some of the issues that must be addressed. For this broad area, focus has been on biomaterials, packaging and technical textiles. Even though materials technology has been developing continuously since ancient times, today's technological materials compare poorly with the performance of materials created by nature. Biomimetics is a class of materials that has the potential for revolutionary innovations.

R&D Policy Actions Required to Consolidate Europe's Position

There are a couple of key issues raised in the SMART results, which have particular relevance for policy-making on EU level as well as on national levels. The national level, however, was not pointed out in mere detail. Thus, recommendations given here are addressed to EU authorities. Some of these seem fairly plain; the challenging part is to actually tackle them.

- Secure Europe's strong position in materials technology by setting up strategic **win-win co-operations with international key players.**

- Strengthen the **public awareness** of materials as being part of Europe's cultural heritage. This could be achieved by actions in the fields of public events, providing materials for education in schools and setting up innovation platforms with fashion makers, architects, designers and human scientists.
- Increase R&D activities in materials technology in the fields mentioned below as well as those in strategic research agendas of specific **European Technology Platforms** by intensive funding, private-public partnership and ensuring R&D friendly regulations.
- Make Europe an el dorado for **excellent materials** researchers on the international level by young scientist competitions, excellent infrastructures and public awareness of their research.
- Further develop the ERA in materials research through **ERANETs, European networks and platforms.**
- Further develop **technology transfer concepts** and strategic research agendas to keep Europe on the edge of technological developments.
- Improve integrated developments approaches through all parts of the innovation pipeline. Increase the number of joint actions with research fields like **ICT, life science, mobility and health.**

Materials technology is in a good position today, however some weaknesses of the European materials innovation system identified in the SMART could develop to a threat in the future, if no action is taken.

More Visibility of European Research Results Needed

The visibility of European research results in publications especially in overarching publications like review papers is too low compared to the quality of the research results. The citation rate of most European materials science papers is relatively low compared to other regions in the world. Therefore scientific marketing strategies have to be developed.

Excellence in Basic Research is only One Step toward the Top Position

A traditional problem of European materials research is the fact, that Europe is excellent in basic research but that technology transfer rates and time to market have to be improved. The transfer of many industrial R&D activities to Asia as well as counterfeiting of innovative developments is a real threat to the European materials innovation system.

Long-term and Reliable Research Funding

Researchers expect predictable long-term funding strategies. The 7th European Research Framework Programme FP7 is an important step towards predictable long-term developments. Since materials are taking up an adequate part in the FP7 in the Specific Programme Cooperation within the theme 4 Nanosciences, nanotechnologies, Materials and new Production Technologies (NMP), excellent conditions for a continued successful development of European materials technology are given. For the first time the European Commission will also support fundamental science in the Framework Programme and established the so-called European Research Council - ERC. The ERC could give excellent researchers a European perspective.

Simplifying Bureaucracy

Recently the European Commission started activities to reduce bureaucracy by simplification. Simplification actions have been taken in all political sectors and therefore also in the area of research and innovation. It is still unclear, if the right steps to reduce bureaucracy have been taken and a lot more effort is needed. In the area of European materials research funding the Commission introduced a two-stage proposal submission system and reduced the number of funding instruments. This should help to minimize oversubscription and give applicants a clear orientation.

Strategic Decision Making and Innovation Transfer

Crucial for the success of the European materials innovation systems are the right decisions about relevant up-coming research topics and actions to improve technology transfer. There are many relevant European foresight activities in materials science. Cooperation between different strategic materials activities such as European Technology platforms EUMAT, SUSCHEM, Forestry Platform, the Steel platform and materials relevant ERANETs like MATERA, Chemistry and ACENET should be further improved to obtain a dialogue process about the future of European materials R&D. First attempts have been made by setting up the network MaterialsEuroRoads, a dialogue platform for materials foresight experts, and the MATERA outlook Conferences.

Another very crucial question is how to improve the number of successful technology transfers, the time to market and how to ensure that legal rights are not violated outside Europe. Many different actions have been started in the past in this area, finding an efficient working solution will be a critical success factor for European R&D in materials technology.

Materials Research Priorities

For the three identified socioeconomic inputs where Materials Research can contribute heavily, the identified research priorities for materials are listed below. The specific bottlenecks identified regarding these research topics are pointed out in the final report of SMART - see Reference and Link section.

Energy
Energy is a strategic resource for industrialized countries. The development of future energy technology is of great importance for Europe. Energy safety and CO_2-reduction are the main drivers in this field. The following research priorities are among those that were identified:

- Innovative gas separation membranes for CO_2-capture technology
- Materials for white light emitting devices
- Polymers and materials processing for organic light emitting devices
- CO_2-reduction in mobility: light weight alloys, nano-composites and biocomposites
- Materials for superconducting devices
- Advanced corrosion resistant (less degradable) materials for various renewable energy sources
- Energy storage materials
- Advanced joining techniques for manufacturing of wind generators
- Ceramics for solar power tower technology
- Materials for 3rd generation solar cells.

Security
Materials for security applications are not at the forefront of security research. Materials research can pave the way for a wider application of sensor technologies through the development of advanced sensor materials for detection systems with increased sensitivities and selectivity as well as for ease of manufacturing. Materials research could also be an important factor in making these technologies widely available.

Smart materials, polymers and nanomaterials are on the way to revolutionizing security technology in the areas of protection by innovative armour and in the field of anti-counterfeiting. Because threats of terrorism, various peace-keeping missions world-wide and anticounterfeiting of European products are relevant areas for European politics, materials research priorities are:

- Smart materials and nanomaterials research for protection as well as for the development of sensors to improve the security of European citizens and peacekeeping forces
- Advanced polymers and nanomaterials for anti-counterfeiting systems to secure Europe's global market position in high-added products.

'Better Life'
Among the identified research SMART priorities in the area of **Biomaterials and Materials for Medical Applications** are the following:

- Surface modification technologies for producing innovative multifunctional coatings on implants
- New production technologies for smart materials
- Stimuli responsive materials - esp. SMP - for smart surgery tools and high-tech artificial implants
- Materials for adaptive drug-device combinations
- Basic research on heterogeneous materials interfaces for prosthetics to enable disabled citizens a better participation in social life

Materials Packaging
The identified materials research tasks are:

- Nanotechnological improvements of packaging materials
- Improving the materials performance of bio-based polymers
- Intelligent polymers for printed electronics
- Sustainable materials for smart packaging

High Tech Textiles
Materials research priorities in the area of high tech textile materials are:

- Intelligent polymers for smart textiles
- Nanotechnological improvement of technical textiles

Sources and Links

- Schumacher, G.; Preston, S.; Smith, A.; Sajgalik, P. et al.; Future Perspectives of European Research, expected Sept. 2007
- www.materialseuroroads.net
- www.smart-ssa.net

for roadmaps:

- www.smart-ssa.net/c3/index.php?index=22

Regional Infrastructure Foresight

Authors:	Eckhard Störmer, eckhard.stoermer@eawag.ch; Annette Ruef, annette.ruef@eawag.ch; Bernhard Truffer, bernhard.truffer@eawag.ch
Sponsors:	Swiss National Science Foundation - National Research Programme NRP 54: Sustainable Development of the Built Environment
Type:	Single issue: regional sanitation systems; development of strategic planning methodology
Organizer:	Eawag, The Swiss Federal Institute of Aquatic Sciences and Technologies; Empa, Material Science and Technology; Fraunhofer Institute for Systems and Innovation Research; University of Berne; Swiss Federal Institute Zurich
Duration:	7/2005-6/2008	Budget: € 215 700	Time Horizon:2030+ (25 years)	Date of Brief:Sept. 2007

Purpose

"Regional Infrastructure Foresight" enables municipalities, engineers and decision makers in regional sanitation systems to develop a mid- to long-term strategy for a sustainable sanitation infrastructure. Identification of uncertainties and future challenges of the regional infrastructure's context is carried out in a participatory scenario process. A broad range of possible integrated solutions for the sanitation system is evaluated from different stakeholders' views. This approach allows handling of uncertainties of frameworks, and of complexity of the system to find more adaptive system configurations for a sustainable sanitation system.

Handling Uncertainties & Enabling Systems Change

Water infrastructures are characterized by a stable socio-technical system: Inert long-living technologies and corresponding expert systems of planners, technology suppliers and regulators exhibit strong path dependencies. The system tends to perpetuate predominant paradigms and thus to risk missing out on more sustainable alternatives. New incremental or more radical technologies are on the market or in development but have only little chances to grow out of niche markets.

Sanitation infrastructure in industrialized countries was primarily erected in the 1960ies to 70ies. Nowadays many elements of the sanitation system reach the end of their lifespan and solutions for re-investments have to be found. The solutions have to face new challenges like increasing variability of wastewater streams, micro pollutants, stronger regulation etc.

As an answer to enormously increasing resource use and rising burdens on environment and human health, the Swiss National Science Foundation research program «sustainable development of the built environment» (NRP 54) is developing scientific principles that will help to bring about a more sustainable development in Switzerland's towns and cities, as well as its infrastructures.

Within this program, the research team of Eawag Cirus developed a foresight and strategic planning approach, which allows to integrate uncertainties and to find innovative solutions for a more sustainable sanitation system. The method is tested in three case studies in different Swiss regions. The project is carried out jointly with national and regional water management agencies, the national water pollution control association and engineering consultants that see the need for a critical reflection of established systems.

Focus on Pragmatic Planning Tools

The "Regional Infrastructure Foresight" – RIF - methodology is developed to support strategic decision making for sustainable infrastructure planning. The foresight approach shall empower local and regional authorities and sanitation professionals to decide on mid- to long-term strategies for infrastructure development and to manage potentially sustainable innovations in a strategic way. RIF therefore combines elements of methods for regional governance, strategic planning and technology assessment.

The methodology itself is the result of the project. It provides a framework for strategic planning in the sanitation sector with the potential to transfer the approach to sectors with similar characteristics. Main purposes of the methodology are:

- Identifying particularly uncertain future challenges of the regional sanitation system;
- Assessing a broad range of solutions including radical alternatives to think off the beaten tracks. In particular, conventional system boundaries - such as the size of the catchment area or the range of the organization's infrastructure tasks -shall be questioned;
- Mapping out the goals and targets of the public task

sanitation to integrate multifaceted expectations of different stakeholders. A broad range of perspectives and value positions shall be involved in mobilizing broader resources of knowledge stocks and in enhancing the acceptance of innovative options;
- Developing a strategic plan in terms of a recommendation of principal long-term pathways for a sustainability oriented regional sanitation system.

Participatory Foresight Approach

According to figure 1 structural characteristics of the RIF methodology are
- Three levels of intensity in participation:
  - Core team of about 4 local decision makers, which analyze the relevant steps and prepare the stakeholder workshops
  - 15 to 25 stakeholder representatives collaborating in the identification of future scenarios and the evaluation of options
  - actual decision makers in the region reflect the gathered results and decide about the next steps in the planning process
- Reflexivity with regard to the object of analysis and its potential extensions: Definition of time scale and regional application area of the planning procedure. Specification of relevant stakeholder groups in the region with regard to the conventional planning and decision processes in the regions concerned.
- Open and participatory approach to decision making: Decision makers have to open their decision making processes to more public discourse and involve diverging inputs form different stakeholders. The result of the planning shall serve as a starting point for more detailed planning and decision processes.

Based on these structural characteristics, a foresight process has been carried out with the following phases
- **Preparatory phase:** analysis of situation, delimitation of object of analysis, identification of key stakeholders, establishment of performance contract with research team
- **Analytical phase:** Identification of relevant context conditions and options, elaboration of value tree and sustainability visions in the region. This step is worked out in the core team and in the context of a two-day stakeholder workshop.
- **Evaluative phase:** Assessing the strategic options against the background of the context scenarios and the values weighted by the preferences of different stakeholder groups. This leads to specific rankings of stakeholder groups and identification of conflict lines – one-day stakeholder workshop.
- **Implementation phase:** Presenting the results to the decisions bodies, determining the application context of the identified alternatives, resolving an agenda for a more detailed planning process.

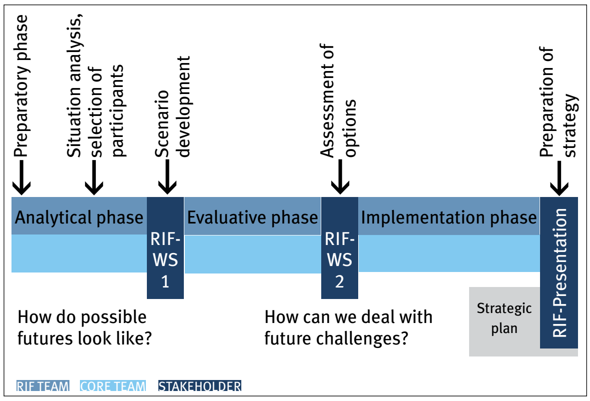


Figure 1: Process scheme of RIF

Scenarios, Goals and Options

In the following, the main generic results of the case studies are presented. These are context scenarios of regional development, value trees, and technical and organizational constructions of options.

From 'Blooming Growth' to 'Catastrophe'

Regionally specific context scenarios were built in the stakeholder workshops. The participants identified regionally relevant factors. Major factors and drivers of the scenarios are mainly economic and societal developments, which influence settlement structures, consumer and production patterns, as well as regulatory questions of wastewater pollution control. Two main dimensions of problem pressure and problem solving capacity describe a problem-oriented categorization of the scenarios developed in the case studies. Problem pressure is described by the requirements for the sanitation system, such as the variability of wastewater streams, and regulatory and societal demands for the system. Problem solving capacities for the public task sanitation depend on the economic capacity of the region and on the fragmentation of the community structure of the region.

Three generic types of context scenarios, which result from an analysis of the specific participatory built scenarios in the case studies, showed possible but uncertain developments. Main drivers were economic growth and the amount of pressure on the sanitation system:
- "Region light" is a shrinking region with decreasing demands on the sanitation system. The key challenge is a low ability to pay for infrastructure services. Problem solving capacity is low, but problem pressure is also low. A maintenance and operation of infrastructure on a moderate level is usually possible.
- "Blooming growth" is a situation where quality of life is an important driver for the attractiveness of the region.

The inhabitants request high environmental standards. High problem pressure with high problem solving capacity lead to a situation where efficient and effective infrastructure services can be established and operated.
- "Strong globalization" is a picture of a region, which is driven by decisions of global headquarters, which open and close their production sites on short-term request of the international market. With this situation unemployment rates go up and economic situation is more or less precarious. It is nearly infeasible to plan the variability of wastewater streams. Problem pressure is high and problem-solving capacity is quite low. This situation can lead to a "catastrophe" where infrastructure cannot be maintained any more.

In addition, possible impacts of climate change are considered in one or several scenarios. In the case studies the scenarios were regionally specified and vary from these generic types.

Value tree of sustainable sanitation

The sanitation system as a public task of water pollution control and safeguarding of hygienic standards follow a range of goals within the whole range of sustainability pillars:

- Ecological aspects are water pollution control, minimizing resource use and recycling of resources, risk prevention.
- Social aspects are health promotion, accessibility to the service, equitable and affordable cost of the services, and intergenerational equity.
- Economic aspects are efficiency and effectiveness, cost transparency and adaptability and openness for innovation.
- Governance aspects are political participation and legitimacy, controllability, and ability for coordination.

These goals vary in their relevance in different context scenarios; which can be critical or supportive of meeting the challenges of the scenario worlds. The goals are assessed with different priorities and values from different stakeholder groups. This makes conflicts about different demands on the sanitation system transparent and helps to anticipate possible sustainability deficits.

Technical and organizational options

Main trends in sanitation systems and technologies in general are on the one hand heavy increase in WWTP sizes as an intensification of today's dominant design. On the other hand, decentralized on-site WWTP improve their technologies and therefore their reliability and user friendliness with a decrease in costs. Beside these incremental to radical technological innovations, other elements of the sanitation system have to be taken into account for an integrated view.

In the RIF process, strategic options are developed in the core team by analyzing the major technological and organizational elements that might form a future sanitation infrastructure.

A few basic parameters define the configuration of a sanitation system and offer different possibilities for change according to the regional situation. These are:

- degree of centralization within the catchment area (e.g. central plant, on-site preliminary purification, decentralized WWT),
- technology of sewerage (e.g. combined or separated sewer system),
- sludge treatment (e.g. drying, digestion, gas production),
- thematic focus of infrastructure services (e.g. operating only WWTP, or including sewerage, drinking water system, waste management),
- organizational form (e.g. association, public firm, private firm in public ownership, privatization),
- allocation of fees (e.g. uniform fees, polluter pays principle).

Basic strategic options can be derived by combining these parameters into coherent system configurations. The options developed in the case studies represent corner stones of a continuum of options.

In the stakeholder workshop tapered options close to the edges of the continua are assessed to get clear differentiations and trade-offs between the options. Within this field various sub-variants are possible. For the final recommendations, the basic options are enhanced to coherent combinations of their sustainable elements to new options.

Sustainability assessment of strategic options

With the assessment of the given options by different stakeholder groups in different scenario contexts a broad field of arguments pro and contra the options is delivered. Different preferences of options between stakeholder groups in one scenario world show potential dissent and conflict lines. This procedure simulates a virtual political decision, and opportunities and threats for the sustainability of their implementation are made obvious. The comparison between the assessments of options in different scenarios provides the framework conditions under which options are more or less appropriate. It also gives advice to sanitation professionals, which context developments have to be under control in a kind of trend monitoring to use early signals for the fine-tuning of strategic plans. These results allow delivering a detailed overview of strategic options and suitable sub-variants, considering uncertainties of context development, technological innovations and organizational possibilities.

Regional Infrastructure Foresight as a New Governance Approach

Infrastructures typically have a long lifetime. They are usually not flexibly adaptable but have to be appropriate over the whole time span of 25 years in the case of WWTPs. To find long-term fitting solutions, planning faces high requirements. However, conventional sanitation planning approaches contain deficits: They do not deal with uncertainties of future developments of framework conditions in a transparent and comprehensible way. For several reasons they are usually not open for innovative technologies of system configurations. With the RIF methodology, we propose a different kind of planning which comprises uncertainties and opens the discussion on a broad range of integrated sanitation system solutions. Moreover, the highly participative methodology can be seen as a new governance approach to infrastructure management.

Participation for visioning and learning

The scope for action of infrastructures in general, and sanitation system in particular, get more dynamic and are confronted with growing uncertainties due to globalization, liberalizations in infrastructure markets and technological innovations. Foresight helps to think ahead to be prepared for new challenges and to integrate adaptability and flexibility of solution from the beginning.

The RIF method uses a participatory development of context scenarios and evaluation of options for two reasons: to integrate tacit knowledge of different groups on possible future developments, to build awareness of the range of possible futures with their variety of relevant challenges, and to allow a critical reflection of the opportunities and threats of conventional and innovative solutions.

The intense work of the core team of local decision makers in the sanitation system opens a learning process on strategic long-term planning. The assessment process that is usually carried out in a black box by planning engineers is made transparent and traceable. The stakeholder discussions simulate political decisions and deliver argumentations for the real policy process. In the RIF procedure, the participating stakeholders are multipliers for the favoured solution.

Dissemination of strategic infrastructure planning

With the participation of the official from the regulatory body of the Swiss canton - i.e. federal state - lessons form one exercise can be transferred to other organizations in the same canton. It could become a core activity of the cantonal office to support this kind of strategic planning processes in the different regions and to support synergies between the different processes. If carried out in different cantons this may ultimately create a background for national organizations and federal offices to discuss and implement radically new technologies in sanitation. A coordinate set of RIF procedures could now create momentum for reforming the whole sector.

Key requirement and limitations of the RIF approach

To carry out a RIF procedure, open-minded participants are needed especially in the core team. Core team members have to be part of the decision-making bodies. They have to be prepared to reflect today's system with its goals, habits and standards. Additionally they need a basic ability for strategic thinking.

Obstacles to favour radical system changing innovations are high, even in this open process. Uncertainties of their feasibility in area-wide application and trust in their reliability are too high to be accepted today. In contrast to conventional planning processes however, radical options such as decentralized WWTPs are discussed and recommended for use in pilot cases and niche markets.

A RIF procedure delivers a recommendation for a strategic orientation of the regional infrastructure system. This provides the base for policy making in the public sanitation boards. Technical planning with feasibility studies can then be undertaken according to the results of the RIF process.

The RIF methodology thus offers a new governance approach to sustainable infrastructure planning at the regional level.

Sources and References

A handbook on the method will be published in 2008: **www.nfp54.ch; www.cirus.ch**

England's Rural Futures Project: Scenario Creation & Backcasting

Authors:	Sami Mahroum, sami.mahroum@arcs.ac.at			
Sponsors:	The programme was initiated by DEFRA Department for Environment, Food and Rural Affairs.			
Type:	regional			
Organizer:	The Future Foundation and the Centre for Rural Economy at Newcastle University.			
Duration:	One year	Budget: £ 125 k	Time Horizon: 2024 and 2054	Date of Brief: Aug. 2007

Purpose

Rural Futures is a study of what the English countryside might look like in 20 and 50 years time from a social geographical perspective. Its overall purpose is to help policy makers and local communities clarify their objectives for the future and what needs to be done over the next few years to ensure that they are on a trajectory towards a desired and feasible scenario. The project addressees are therefore decision makers in all levels of government.

From Backcasting to Recommendations about the Future

The foresight project had the following objectives:

- To build a 'futures' knowledge base to support a participatory process of scenario building and predictive forecasts,
- To conduct a backcasting process to discuss what policy interventions might be required to make the desired scenarios - or aspects of a scenario - a reality,
- To assimilate the learning into a set of clear insights and strategic recommendations,
- To conduct an appraisal process to assess the success of the scenario-building and backcasting techniques.

Iterative Approach

The project comprised a number of iterative stages:

- A **Rural Futures Knowledge Base** was created, summarising existing data and knowledge of key drivers affecting the countryside now and in the future.
- A map of the differentiated countryside was created through a statistical analysis of the 1991 and 2001 census.
- **Seven scenarios** were constructed, three 20-year scenarios that were created using a multivariate modelling of most influential drivers of change - selected by the project team and vetted by the Steering Group, and four 50-year scenarios were created through a one-day workshop to which Blue Skies experts provided a view of change over a 50-year time horizon in a range of fields. The scenarios were presented in the visual forms created as part of a wider explanation of the process, to different groups for consultation.
- Four **public focus groups** were held in Ashford, Kent and Alnwick, Northumberland in which participants also built their own 20-year scenarios and commented on the 'expert' visions.
- A one-day **stakeholder workshop** with 50 participants drawn from the widest possible array of rural stakeholder organisations was held.
- Descriptions of the scenarios were placed on a special section of the **Future Foundation web site** and over 200 organisations were invited to give feedback. 56 forms were received via the web site and 16 via email and post.
- Initial backcasting analysis by the project team informed the design of two participative and highly structured **regional backcasting workshops** – one in Northumberland and one in Surrey in which groups worked to selected desired or to be avoided outcomes from the 50-year scenarios, and identified the actions and decisions that would be needed to create this future.
- Four Project Steering Group meetings were held during the course of the project at which advice, comment and input on the project design, objectives and implementation was sought and fed into the iterative process. This Steering Group included representatives from Defra's Horizon Scanning Team, Defra's Science Directorate, the Countryside Agency and English Nature.

Three '20-Years Scenarios': Fostering the Distinctiveness of the Countryside

The three scenarios for 2024 were: *The Consumption Countryside; The Rise of the Rurbs; and Twenty-First Century Good Life*. Projecting present social and economic trends and then making different assumptions on factors that would affect the balance of different types of rural areas across the country derived these scenarios. The most important of these assumptions were: the nature of future planning and building policies and the degree of attachment we have as a society to preserving and fostering the distinctiveness of the countryside.

The *Consumption Countryside* is effectively a 'central' scenario based upon what are considered to be the most likely outcomes in these regards. The two 'alternative' scenarios are those that would result from a divergence from anticipated trends, The Rurbs resulting from liberal planning policies allowing 'rural suburbs' to spread and the 21st Century Good Life resulting from stronger planning controls and investment in protecting the countryside.

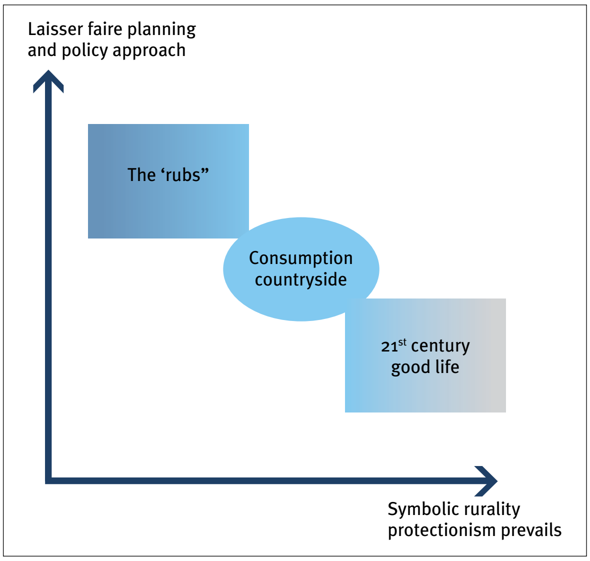


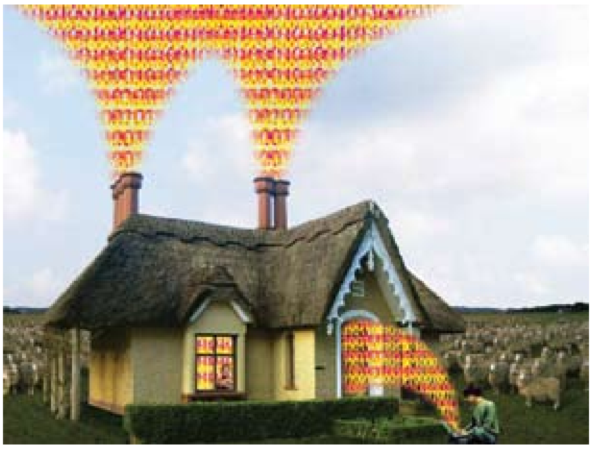
Figure 1: Three scenarios for 2024

The '50-Years Scenarios': Four Types of 'Rural Idyll'

Each of the 50-years scenarios represents a different type of quality of life that might be available in the future and would therefore imply different evolving understandings on the part of the population as to what 'rural idyll' meant.

The four scenarios were the following:

Vibrant Variety is relatively socially and economically liberal, and has freedom and diversity as key elements of its idyllic appeal.



Garden and Guilds is economically dynamic, but with activity rooted in strong, but modern social networks.

Preserved Heritage has heritage environmental protection as the key elements of its idyllic appeal.

Fortresses and Fences is based on an economically liberal model in which the rural idyll is overtly aspirational – only available for the wealthiest in their enclosed, privileged and privatised areas.

Key Findings

There are a number of key points that have emerged from an examination of the scenarios and the backcasting outputs that appear to offer significant insights into the nature of the challenges facing Defra in its strategic planning and futures work.

No single scenario delivers all of government's – Defra - strategic objectives: First and foremost is the simple observation that there is no one scenario that delivers strongly on all of government's objectives for the countryside as itemised in the Rural Strategy Review 2004.

The challenge is to balance competing objectives: The most obvious policy tensions emerge from the difficulty in balancing activities that are currently conceptualised as oppositions: economic liberalism and social inclusion; environmental sustainability and a more liberal planning regime.

Innovative and creative policy approaches are required: People remain hidebound by stereotypical views despite the enormous efforts made in the scenario creation process to shift perceptions and encourage fresh thinking about the components of the rural future and how these will interact.

No major disrupting events are expected and strong social norms will continue to lead the future: The scenarios do not effectively embody the impact of any major disruptive events in the future.

Key objectives are conceived as outcomes and not seen as directly created by policy action: Only certain components of the rural future are conceived as actively shaping the future - such as the economy, transport and education - whereas those that represent many of government's objectives - good environment, biodiversity, social inclusion, quality of life - are conceptualised as outcomes, not drivers.

Major ethical questions are raised about the nature and beneficiaries of the scenarios: Each scenario raised major ethical questions amongst participants and consultants, particularly during the Backcasting workshop, about the nature of the future world and who would be the major constituents and beneficiaries of the countryside.

Creating a coherent view of urban-rural inter-relationships is vital: Throughout, the problem of creating rural scenarios without specific reference to urban developments is highlighted. Every scenario implies the relative development and attractiveness of urban centres that would make a particular scenario likely or feasible. An integrated future reality of rural, urban and suburban areas is assumed if not made explicit.

Policy integration across all departments is essential: The strong social nature of scenarios highlights the requirement for effective integration of policy formulation and delivery across all government departments impacting on the rural population. There has to be the ability, when creating and dissecting future visions of this kind, to address all aspects of the future society that they depict and address the future needs of the population.

Can Rural Life Compete in the Long Run?

A number of other specific issues have emerged for policy-makers to consider:

- The degree of rural subsidy implied by any trajectory and whether this is likely to be sustainable in the political environment expected over the next 20 years – and to what extent different scenarios and hence trajectories will be affected by a change in political environment or the economic growth necessary to support subsidy.
- The role of innovation and enterprise in diversifying the economic base of rural areas and integrating them into nearby urban and global economies. It is unlikely in any scenario that traditional rural activities will generate economic growth without the multiplier effect of new occupations and/or large subsidy.
- How to maintain the aspects that potentially give rural areas a competitive advantage in attracting visitors, residents and economic activity. Particularly important, apart from infrastructure issues, may be how to ensure that the social and cultural capital associated with rural settlements is maintained as the economic and population base changes.

- **Thinking more creatively about what can be positive assets of rural areas** – such as older people – and what mix of services and support is necessary to support and develop those assets.

Sources and References

Scenario Creation and Backcasting: Summary Report and Recommendations: A Future Foundation Report, 2005. http://www.ncl.ac.uk/cre/publish/otherpublications/ruralfuturesprojectfinaldec05.pdf

Austria's Futures: Past Perspectives and Present Expectations

Authors:	Susanne Giesecke, Susanne.Giesecke@arcs.ac.at			
Sponsors:	Exchange Program „Stanford in Austria", Österreichische Gesellschaft für Technologiepolitik - Austrian Association of Technology Policy, private sponsors			
Type:	National foresight exercises with emphasis on microelectronics and nanotechnology, in part historical			
Organizer:	Robert Textor, University of Stanford, Ernst Eugen Veselsky, Österreichische Gesellschaft für Technologiepolitik - Austrian Association of Technology Policy			
Duration:	1983, 2005	Budget: n.a.	Time Horizon: 2005, 2025	Date of Brief Aug. 2007

Purpose

The Brief covers a foresight exercise that is unique in so far as it revisits the projections and scenarios of a historical foresight undertaken in Austria in 1983. It was about the challenges and changes that Austria would have to meet up to the year 2005. Not only are these scenarios revisited but also compared with the reality of 2005. In a further step, a second foresight activity of this kind was started to build scenarios for Austria's future in 2025. The experts of 1983 saw the microelectronic revolution as the technological pace maker of the future. 20 years later they tried to assess the actual impact of this technological progress on various parts of Austrian life.

The Expected Impact of Microelectronics

The beginning of the 1980s was marked technologically by the microelectronic revolution. Back then, many people expected this technology to have far reaching impact on our every day life, on the organisation of work, on other technologies, on the economy and on international relations. As part of a US-Austrian exchange program called "Stanford in Austria" a group of futurists initiated a unique foresight process to assess how these different sectors and how the 'Austrian Well-Being' would be affected by this technological change. In addition, activities were to be discussed on how to improve Austria's strengths and how to encounter the weaknesses.

The results were revisited in 2005 – in part by the same group of experts, in part by others – and compared to the reality. The foresight process was than, in 2005, completed by another look into the future and by drafting scenarios for the year 2025. The group of experts combined engineers, economists, social scientists, editors, managers and anthropologists.

Ethnographic Futures Research

The method chosen for the first foresight exercise was a rather unusual one and one that we do not encounter frequently in other foresight exercises: The Ethnographic Futures Research (EFR) method was developed at Stanford University in 1976. As the title indicates, it combines research on the future with ethnographic research. It is based on interviews with people from the ethnic culture to be researched asking them to reflect form and structure of their own culture or socio-cultural system.

In the case of the first foresight of 1983, 32 high ranking personalities of Austria were asked to give their perception of Austria's future in terms of employment and work life, energy, social values, education, terrorism, medical research, internationalisation etc. These experts were asked to build three scenarios each: a positive, a negative and a most realistic one.

In 2005, 11 of the former interviewees could be motivated to reconsider the results from the historical exercise and

to give account of possible future developments affecting Austria. EFR was applied once more. Another 10 honorary Austrian persons could be recruited to revisit the results from the first exercise and to take part in the new one as well. Most of the interviewees were professors from Austrian universities.The interviews were executed and recorded by students especially trained for this exercise. Prof. Textor of Stanford and Veselsky, the organizer of the 2nd exercise, did the synthesis and analysis.
This foresight exercise is also an evaluation of the first foresight exercise. It rarely happens that scenarios are revisited after more than 20 years to assess what became true and what did not.

Trends of the Scenarios for 2005 and their Realization

Energy

Scenarios: The use of non-renewable resources was expected to profit from new microtechnologies with regard to energy saving options. Experts expected in their optimistic scenarios that questions of environmental protection would prevail. The pessimist scenarios foresaw that the northern industrialized states would not agree to reduce energy consumption.

Reality: The development of wind energy and its feeding into the energy supply network was supported through tax benefits – publicly much criticised for its costs. Transfer of truck traffic to railway failed. Austria also failed to meet the international standards of CO_2 reduction. Austria has to import nuclear energy from abroad in order to meet the rising energy demand. Cargo transit by trucks has exceeded limits and arouses the protest not only of environmentalists.

Work life

Scenarios: Expectations in terms of work, work organisation, working hours, productivity and salary were ambivalent. Interviewees saw work become less strenuous thanks to the microelectronic revolution. They expected, however, that growing international competition would exert pressure on education standards and wage level. Labour unions would lose power and microelectronically based machines would actually be used to keep workers under surveillance.

Reality: Technological progress through microelectronics has indeed made physical strenuous work easier. Demand for high skilled labour has increased. So has the gap between high and low skilled labour. It cannot be stated however, that employment in total has increased due to the advances of microelectronics. The deregulation movements and lay offs stalled even the boom triggered by the telecom branch. The intensity of work, at least as the Austrian workers perceive it subjectively, has increased. Reduction of working hours could not be realized, instead early retirement increased in order to prevent rise in unemployment.

Medical Progress

Scenarios: Medical standards were expected to improve as a consequence of microelectronic progress; so would life expectancy and possibilities of self-organisation at high age.

Reality: The conditions for health were overall judged to have improved except for long working hours and increasing air pollution. New diagnostic technologies, electronic monitoring of health data, the use of sensors for advanced treatment technologies can be considered technological progress. Overall life expectancy in Austria has increased; gerontology has become a medical and political arena of its own. On the downside the experts mention the increasing complaints about stress, especially at the work place.

Education

Scenarios: All experts were of the opinion that microelectronic products, data communication, networks etc. would prevail in schools by e.g. monitoring the things learned or by advancements in self-education via computer. Some of them also expected that microelectronic products would compensate for some insufficiencies of the Austrian public schools system: superficial memorizing of facts instead of acquiring valuable knowledge. Further positive connotations were that all, old and young people would learn how to work, communicate, earn money, organize leisure time with the help of the computer and that such devices would be 'demystified'.

Reality: The experts state that standards of skills are increasingly drifting apart and so are income differences. Basic skills of elementary education were alarmingly low as the PISA-tests results repeatedly showed. On the level of higher education, however, electronic data processing and the features associated with it were widely used and contributed to an increase of knowledge and exchange.

Social Order/Social Partnership

Scenarios: The use of microelectronic products would maintain the well-functioning system of balance of interest and the traditional Austrian social partnership. It would serve as a supporting pillar to adjust to the challenges brought about by the EU, globalisation and international competition. New possibilities of microelectronics would offer more access to information and to participation. Pessimists were afraid that international corporations would flood the market with new electronic consumption products in a way that would simply overwhelm the regular consumer so that there would neither be any possibility to digest these innovations nor to keep up with the traditional cultural activities. Cultural standards would be destroyed and a new divide would open up between those who were able to handle the new gadgets and keep up with the innovation dynamics and those who wouldn't. A rise of unemployment might go with it. Progress in microelectronics would improve communication and relations between people as space and time would become transcendable. Rise in unemployment, however, would make people aggressively fight for jobs and pose a burden to human relations. It was further expected that the three traditional sectors of the Austrian economy – industry, agriculture and services – would be complemented by a fourth one: data processing.

Reality: The experts draw a rather negative picture of what was left of social partnership in 2005. Rather than finding a balance between employees and employers, the major influence, they say, has shifted in favour of the corporations. A further argument is that microelectronics and easy access to information have minimized the information advantage that the social partners used to have from their in-house statistics and networks; thus making some of their traditional functions obsolete.

Although it is hard to see a direct or even indirect causality with technological change, some experts lament that the once consensus based Austrian society has been transforming to a more conflict oriented and increasingly competitive one. This chance is associated with the increasing influence of US capitalism, the access to the European Union and the overall globalisation. Further social problems were seen by the effects globalisation has on other regions of the world, especially the poor ones. This means that more people from abroad had an incentive to migrate to wealthier countries such as Austria, where problems of integration and multiculturalism arise.

Conflicts that used to be solved behind the closed doors of social partnership were increasingly debated in the media thereby politicised and polarised thus giving the social partners less and less chances to govern.

The experts identified effects on Austrian heritage and culture as electronic media became more pervasive and gave other cultural media - national and regional - less room. This can probably be debated as many other expert statements and findings. Not foreseen by the experts was the pervasiveness of mobile communication.

Terrorism & Crime

Scenarios: Microelectronics was seen as both: opportunities to fight terrorism and crime as well as new means for terrorists and criminals to threaten people and nations. Pessimistic views among the experts foresaw that civil rights would be curtailed in order to fight terrorism and crime.

Some chances were seen for Austria by increasing its international position as a neutral country, e.g. using microelectronic devices and product as alternatives to military applications in order to support developing countries.
Reality: These expectations became true to a large degree, though the circumstances that contributed to most of them were not foreseen: The breakdown of the Soviet empire and the shift to a uni-polar world order contested by fundamentalist terrorism. Austria has realized quite the contrary in terms of support for developing countries: Supplying long-range missiles for Iraq approved by the USA. Austria's significance as a mediator for international conflict regions has deteriorated.

Austrian Culture and Internationalisation

Scenarios: The future and continuity of Austria's culture under the auspices of the microelectronic revolution were seen as ambivalent. Optimists hoped that the Austrian cultural heritage would be preserved and could even gain from microelectronic innovations and that the Austrian self esteem would profit from it. Especially TV and broadcast stations would gain from technological progress and become independent from the dominant German media that is broadcast to Austrians. Pessimists were afraid that the internationalisation would bring about a standardisation of culture and would destroy the Austrian "high culture". Standard German would dominate as a language and eliminate regional dialects and patois.

Reality: The variety of TV and broadcast stations has increased immensely, more though by international than by Austrian providers. The banality and arbitrariness is lamented by the experts, not only with reference to the content produced by the broadcast stations but also by the internet.

Microelectronic Revolution

The expectations associated with the microelectronic revolution were rather high not only in terms of impact on the economy but also in terms of technological progress in other sectors, changes in society, security, education, media etc. In retrospect one of the expert participants of this unusual foresight exercise uttered the opinion that the contribution of microelectronics to productivity increase was actually quite low. Only after users have learned how to adjust work organisation and workflow to the potential of microelectronics was it possible to achieve a strong productivity growth.

Major impacts on developments in Austria, however, are very much connected to some political events rather than to the microelectronic revolution or any other technological development: the fall of the Iron Curtain, Austria's accession to the EU and overall globalisation.

As some experts stated, the momentum to use the microelectronic revolution and create a competitive advantage to become a front-runner in some sub-segments was not seized in Austria as it was in Finland or Ireland. Rather, the paradox phenomenon was that some companies were able to generate high profits whereas the overall wage level did not rise nor did it lead to any reduction of working hours.

What Austria has to Expect from the Future: Scenarios for 2025

The views for 2025 are very broadly highlighting several issues of Austria's future and will be summarized in the following points without any further comments:

- World order will be dominated by a Pax Americana rather than UN statutes imposed by utilising the progress in microtechnologies. This will enhance police state like surveillance rather than the implementation of the Human Rights Charta.
- Austria's influence on EU politics will remain rather marginal.
- Questions concerning transit though Austria will be resolved on the expense of the environment and ecology.
- Social network will become more porous with increased insecurity concerning work place and social benefits; social partnership will not regain its former strength.
- Mass unemployment and social fragmentation are seen as imminent dangers to Austria in the future; the competition for jobs will lead to lower wages and longer working hours.
- The impact of the national government and the Parliament will be reduced in favour of local and regional administrative powers; federal structures will resist reform efforts; political parties will become more alike and hollowed out.
- On the fields of science & technology Austria is not very likely to contribute to radical innovations.
- In microelectronics Austria's excellence will be that of a niche producer and end user - also including the fields of nanotechnologies, biogenetics and micro-optics.
- Austria is most likely to benefit from technological imports: e.g. speech recognition, miniaturisation of diagnostic and therapeutic products, genetic technologies in the agrarian and the health sector and alternative energy resources.
- Software development following niche strategies might still pose a chance to Austria's technological and economic development.
- Access to the Internet will prevail in social groups but also increase the divide between the digital literates and the illiterates.
- Entertainment via the Internet will lead to an even more severe de-politicization of society; democratic participation will only be bogus.
- The increase of the elderly population above age 65 will pose problems to the social security system and new challenges to geriatrics; this might also lead to an impoverishment of some parts of the population.
- For many elderly people new audio-visual technologies will be an essential means to communicate with the world outside their home.

Policy Implications

The group of 22 experts addresses expectations and recommendations to political and economic decision makers. The scenarios and perceptions of the future are constructed from a subjective point of view and the studies were not designed to support political decision-making but to give impulse to discussions about Austria's future. The implicit recommendations are thus rather general and do not bear any surprises. They plead for strengthening Austria as a competitive business location - not at the expenses of liberalizing the social market economy but by building industrial and S&T clusters. Other recommendations are pointed towards improving the national education system and establishing a base for excellence and competence.

The rather mainstream results from both scenario processes, 2005 and 2025, might most likely stem from the fact that even though the group of experts represented several disciplines, they were quite homogenous: representing a specific age cohort, belonging to the same social stratification and all being males. Certainly, each expert represented a specific area of academic knowledge; however they were laypersons in the other fields covered by the scenario exercises. This is one explanation why many statements were rather general, missing some insider knowledge of complex matters.

Sources and References

- Ernst Eugen Veselsky (2006): Die Zukunft Österreichs. Chancen und Risiken im nanotechnischen Zeitalter. Wien: Kremayr & Scheriau/Orac (available only in German)

Evaluating Foresight – The Colombian Case

Authors:	Rafael Popper / rafael.popper@manchester.ac.uk, rafael_popper@yahoo.com Michael Keenan / michael.keenan@manchester.ac.uk, Manchester Institute of Innovation Research - MIoIR Javier Medina / javiermedinav@hotmail.com, Universidad del Valle - UNIVALLE, Colombia, MIoIR
Sponsors:	COLCIENCIAS - Colombian Office of Science and Technology
Type:	Evaluation of Foresight Programme
Organizers:	COLCIENCIAS - Colombian Office of Science and Technology PREST / Manchester Institute of Innovation Research - MIoIR, MBS, The University of Manchester
Duration:	6-9 months; Budget: ca. € 40k; Time Horizon:N/A; Date of Brief:Sept. 2007

Purpose

This brief introduces the evaluation framework designed by the Manchester Institute of Innovation Research – MioIR - for the evaluation of the Colombian Technology Foresight Programme - CTFP. An assessment of the First Cycle of CTFP 2002-2004 carried out by PREST - now MIoIR - produced the 2004 Recommendations to CTFP report by Popper and Miles, 2004, that was used to reshape the objectives and activities of the Second Cycle of CTFP. The current evaluation framework is a follow-up of these activities.

Building up Broad Competencies in Foresight

Foresight practices in Colombia began in the late 1970s, however it was not until the late 1990s when some capabilities where built in some universities and regional research and technology development – RTD – centres. See also Medina and Ortegón, 1997. In the early 2000s the country already had over 50 experiences in a wide range of topics and sectors with different territorial scope, e.g. international, national and sub-national. In parallel with these events CTFP has been involved – either as main sponsor/organiser or contributor/supporter – in around 30 studies since 2000. Today, CTFP is among the most interesting experiences in the Latin region. There is a mix of national and sub-national studies on sectors, themes and territories, thus making CTFP widely known and respected in Latin America. CTFP has also become a reference point in the Andean countries and experiences are comparable with that of more industrialised countries in the region, e.g. Argentina, Brazil, Chile, Mexico and Venezuela by Popper and Medina, 2008.

From the scientific and technological perspective the Colombian Foresight experiences have been closely related to the developments of the Colombian Office of Science and Technology - COLCIENCIAS. Such interest dates from the early 1970s with projects such as "Colombia Operation" and has persisted in time with the promotion of several activities focused on the role of S&T for the development of the country. Also important have been the efforts COLCIENCIAS has made in order to: understand global S&T and social challenges affecting the world and, at the same time, build national competences capable of developing nationally-beneficial responses to global challenges.

In the 1980s and the 1990s COLCIENCIAS promoted different types of future-oriented initiatives. Among these projects are: Where is Colombia going? And the Strategic Dialogues dealing with challenges proposed by the Global Dialogues of the 2000 Hannover World Fair? Later in 2002, COLCIENCIAS joined UNIDO's Technology Foresight initiative and subsequently the CTFP was officially launched under the sponsorship of COLCIENCIAS and CAF. Since its creation, CTFP has gone through various phases or cycles - see Table 1.

Phases	Sponsors / Organisers
Incubation 2001-2002	UNIDO and the Ministry of Development organised some initial awareness building activities for different types of stakeholders.
First Cycle 2003-2004	COLCIENCIAS; the Ministry of Commerce, Industry and Tourism; and the Andean Development Bank – CAF - created the CTFP and funded its first working plan.
Second Cycle 2005-2007	COLCIENCIAS and SENA - National Training Service - funded the ongoing agenda of activities and the knowledge platform

Table 1: Cycles of the CTFP

Evaluation Focus: on Vision Building, Capacities and Regional Development

CTFP has three high-level objectives:
- To contribute to the development of a national vision in the transition to a knowledge-based economy,
- To conduct foresight and technology watch exercises in strategic sectors,
- To build foresight training capabilities and absorptive capacity for the appropriation of foresight results.

These are complemented with lower level objectives from the various individual activities that have been carried out in the various cycles of the programme. And given that the evaluation focus is the Second Cycle 2005-2007, the evaluation framework was designed around the three specific objectives of the Second Cycle:
- To build strategic visions – in order to help in the creation of a long-term vision for the country; to help to identify national STI priorities; and to identify opportunities and competitive areas for Colombia in the global scene.
- To build foresight and strategic thinking capacities – in order to create forward-looking capacities in higher education and other institutions, thus increasing the impact of the CTFP; to strengthen human expertise and technological tools and software resources supporting foresight-related activities; and to support the creation of a solid foresight and futures thinking culture.
- To support regional development and innovation – by promoting and supporting regional foresight activities; promoting the creation of industrial clusters; and supporting the creation of regional innovation systems.

Ex post Evaluation

Some of the well-known expected outcomes of CTFP are: the elaboration of public policies; multiplication effect and multi-level presence; institutional development of foresight; promotion of public debate; articulation and appropriation of foresight knowledge; collective learning; intellectual production; foresight culture and development; increase in foresight productivity with experience; among others. These are rather general and require further elaboration; and are perhaps not the ultimate objectives. For that reason, the evaluation framework aims to provide answer to questions about appropriateness, quality and efficiency, and impacts.

There are several questions about the appropriateness:
- What are the programme 'theories'? What theories of learning and capacity-building are implicit in CTFP design and delivery? How sophisticated are these theories and are they well-founded and appropriate for Colombia? To what extent does the programme's perspective correspond with the expectations of other actors, particularly the sponsors and participants of the projects?
- Are the programme theories around CTFP appropriate, given the overall conditions in Colombia and the institutional context of COLCIENCIAS and the other sponsoring agencies? How do they compare to programme theories found in foresight exercises across the Latin American region and in other parts of the world?
- Do expected outcomes tally with programme objectives? And do programme activities tally with objectives and expected outcomes? In other words, is the CTFP internally logical? Given the breadth of activities and their varying objectives, these sorts of questions need to be asked for each type of activity, as well as at the level of the overall CTFP.

In addition, quality and efficiency questions include:
- How were methods selected and used? What types of support tools - e.g. software - have been used? How well have these tools been used? Have the tools and exercises been adapted to local and regional contexts in which they have been used?
- What are the main products and outputs? What is the level of novelty and originality of these outputs? What is the level of access to CTFP products? Have CTFP products complemented or strengthened other governmental programmes? If so, which ones?
- How well was the management of the Second Cycle of the CTFP? To what extent did programme managers learn from the First Cycle review? By Popper and Miles, 2004. How flexible were the activities? Was CTFP capable of committing policy-makers and other stakeholders in its activities?

As for the impact and effectiveness of results, four generic challenges should be highlighted - OECD, 2006, p.179:
- **Timing** – have expected effects come about already? This will take into account that large part of the evaluation is being conducted in real-time rather than ex post. Therefore impacts will be focused on for example, learning, policy recommendations, etc. Given that many impacts will not yet have materialized several alternative indicators would need to be developed in order to measure whether things are moving in a desirable direction.
- **Attribution** – can we confidently assign outcomes to the intervention being evaluated? In other words, is CTFP solely responsible for the observed / reported effects? If not, what contribution has it made? The main challenge here is that people often under-estimate the impacts of activities like foresight, due to difficulties in acknowledging intangibles.
- **Appropriability** – where should we look for effects? Given that learning and capacity building have been the central objectives of CTFP, there is a need for looking across a broad array of stakeholders. And for the identification of policy impacts there is a need for an overall appreciation of the policy systems in the country

and studied sectors - e.g. pluralistic, hierarchical, etc., as well as the periodicity of policy cycles.

- **Inequality** – in general a programme's effects tend to be seen as the aggregation of its various projects, where some are more successful than others. For this reason, as well as for other resource- and time-related limitations, the evaluation approach is based on a handful of case studies, guided by CTFP team members' knowledge of where the greatest impacts are to be found.

Bearing these challenges in mind, the main way forward is the creation of a logic chart for CTFP. A logic chart is a powerful instrument for mapping the linkages between activities, outputs and impacts that need to be assessed - e.g. proposed directions for strategic sectors and technologies, proposed policies and strategies for the transformation of studied sectors and territories, proposed scenarios and visions, etc. This often includes not only the production of reports and the like, but also learning effects, networking, development of critical mass of competencies, formation of trainers - the so-called social appropriation of foresight knowledge -, other measures of behavioural additionality, collective learning, promotion of public debate, development of a national and regional visions, and so on.

The identification of these impacts is only the first step of the evaluation process, given that the use of indicators for assessing whether impacts occurred and their quality would be a major second step.

Real Time and Ex ante Evaluation

CTFP will continue in 2008, with a division of labour between COLCIENCIAS and the new foresight unit in one university in Cali - UNIVALLE. A possible model would be the one where COLCIENCIAS sets the overall objectives and UNIVALLE will act as the implementation agency. Having the future of CTFP in mind, two levels have been proposed for the evaluation of ongoing and future activities: evaluation of the future CTFP structure and evaluation of key stakeholders' perception of the future of foresight in Colombia. The data collection will be mostly through the interviews where a couple of questions on this topic should be included. In addition, an Evaluation Forum has been proposed - see evaluation methodology below - as an instrument capable of providing a discursive space for the sponsors and main stakeholders to come together to think about the future of foresight in Colombia.

Evaluation Methodology

The methodological approach for the evaluation of CTFP is based on a mix of methods and activities.

- **Documentary Analysis** – this requires 'open access' to documents held by COLCIENCIAS and other agencies involved in the Second Cycle exercises.
- **Logic Chart and Indicators** – (as described above) this requires the identification of linkages between activities, outputs and their possible impacts.
- **Surveys** – these are designed for various types of stakeholders, for example a survey targeting co-organisers of sensitivity workshops, an online survey open to all participants in CTFP, and possibly a survey of unsuccessful bidders has also been considered.
- **Interviews** – there are around 50 interviews planned. Most of these have been designed in Spanish to be carried out via telephone, Internet and face-to-face meetings. Target interviewees are key organisers, COLCIENCIAS and UNIVALLE; other sponsors - representatives from international organisations such as UNIDO, CAF, CAB, ECLAC, etc.; influential stakeholders - e.g. ministries, chambers of commerce, regional governments, etc.; executors of Second Cycle projects, i.e. project managers, plus executors from a selection of first round projects; and a small number of co-organisers of sensitivity workshops.
- **Case Studies** – confined to the Second Cycle only, with one project chosen per type of exercise.
- **Benchmarking** – through international comparative analysis.
- **Evaluation Forum** – supported with virtual and face-to-face activities of national and international expert panels.

Appropriateness, Quality and Impact

Since the early 2000s, the Colombian Technology Foresight Programme – CTFP - has been described as a policy instrument with a large mixture of focuses, from economic development to higher education development, to regional S&T development, to industrial development, to capacity building and support to science, technology and innovation policies. However, as any policy instrument, CTFP consumes both time and resources, and for this reason it may be logical to expect that CTFP should be subject to evaluation of a comparable rigour to other similar instruments - see also Popper, 2006.

The evaluation of a foresight programme should be designed in a way that it helps to assess issues around the three main criteria - Georghiou and Keenan, 2008 - described above:

- **Appropriateness** of activities.
- **Quality and Efficiency** of implementation.
- **Impact and Effectiveness** of results.

One major finding from past foresight evaluations has been the importance of aligning foresight with the implementation environment, that is, the policy- and decision-making communities. This is not to say that foresight should not be disruptive, but rather that its impact is strongly dependent on how well stakeholders have been engaged and the processes established for delivering results into the policy- and decision-making arenas. Assessing those linkages represent a significant part of the research approach for evaluating the Colombian Programme sponsored by COLCIENCIAS. Finally, it is important to emphasise that the evaluation approach looks at foresight as a process with five interconnected phases. Miles, 2002; Popper, 2008:

- **Pre-Foresight or Design Phase,** where general and specific objectives are defined, the project team assembled and the methodology designed;
- **Recruitment Phase,** where key stakeholders and individuals are identified and invited to support and contribute to the project activities;
- **Generation Phase,** where 'new' knowledge and visions are produced from elucidating emerging issues or amalgamating existing knowledge;
- **Action Phase,** where prioritisation and decision-making may speed up innovation and change through the promotion of particular policies, strategies, technologies, instruments, etc. – or to changing attitudes and lifestyles;
- **Renewal Phase,** where constant monitoring and evaluation are required in order to assess whether the foresight process has contributed to achieve initial objectives and how far outcomes are being acted on.

Understanding how different exercises conducted by CTFP have carried out each of these phases is a core implicit component of the evaluation framework. However, identifying good practices and learning from possible impacts of CTFP on society as whole are among the most important expected outcomes of the evaluation, given that these will determine the focus, scope and structure of the immediate future of foresight in Colombia.

Sources and References

- Colombian Office of Science and Technology (COLCIENCIAS) – www.colciencias.gov.co
- Georghiou, L. and Keenan, M. (2008) 'Evaluation and Impact of Foresight', in Georghiou, L. et al., The Handbook of Technology Foresight: Concepts and Practice, Edward Elgar, UK.
- Miles, I. (2002), Appraisal of Alternative Methods and Procedures for Producing Regional Foresight, Report prepared by CRIC for the European Commission's DG Research funded STRATA–ETAN Expert Group Action, Manchester, UK: CRIC.
- OECD (2006) OECD Science, Technology and Industry Outlook 2006, OECD Publishing.
- Popper, R. (2006) Evaluación de actividades de Vigilancia y Prospectiva Tecnológica relacionadas con las Áreas Temáticas Estratégicas de los Centros de Excelencia en Colombia, PREST/SELF-RULE report to CTFP-COLCIENCIAS, Colombia.
- Popper, R. (2008) 'Foresight Methodology', in Georghiou, L. et al., The Handbook of Technology Foresight: Concepts and Practice, Edward Elgar, UK.
- Popper, R. and Miles, I. (2004), Recomendaciones al Programa Nacional de Prospectiva Colombiano, PREST report to COLCIENCIAS, Manchester.
- Popper, R. and Medina, J. (2008) 'Foresight in Latin America', in Georghiou, L. et al., The Handbook of Technology Foresight, Edward Elgar, UK.

Opportunities in Innovation for the Dutch Defence Industry

Authors:	Joost Hoogendoorn, Arjan Rensma, Maurits Butter & Annelieke van der Giessen / email address: joost.hoogendoorn@tno.nl			
Sponsors:	Dutch Ministry of Economic Affairs and Dutch Ministry of Defence			
Type:	Single foresight exercise on Defence Industry			
Organizer:	TNO			
Duration:	Jan. – July 2006	Budget: € 150 000	Time Horizon: 2015	Date of Brief: Oct. 2007

Purpose

Under the influence of (inter)national technological, political and economic developments, the defence industry is increasingly intertwined with and developing towards a civil industry. Consequently, the political responsibilities, attitude and measurements are changing for both the ministry of Defence and the ministry of Economic Affairs. An analysis of the Dutch Defence Industry helped to determine the main innovative opportunities of the industry, and identifying the accompanied technological competences needed to make the most of these opportunities. Also strategic vision, including options for innovation policy was developed.

Transition of Defence

Historically, "Defence" supports national strategy, in which nations have built their own forces, defence industry and knowledge infrastructure. Consequently, within nations there arose a demand driven chain with a solid and confidential relationship between the parties in a closed chain, also discerning the industry from 'civil' industries. However, technological, political and economic developments in the last twenty years are changing defence radically. Issues such as the end of the Cold War, decreasing budgets, international cooperation, international organization of forces, industries and knowledge infrastructure, growing use of civil technologies, civil industries and civil markets, 'the war on terrorism', and homeland defence have entered the stage. Consequently, the political responsibilities, attitude and measurements are changing for both the ministry of Defence and the ministry of Economic Affairs, while the defence industry and knowledge infrastructure is increasingly intertwined and developing towards a civil industry and knowledge infrastructure. This critical transition of the defence chain demands timely strategic information and a vision to anticipate effectively. For ministries this means a clear view on responsibilities, effective investment strategies for a capable future force and an effective industry and innovation policy. The defence industry increasingly has to determine their most favourable innovative possibilities.

Developing a New Strategic Vision

As a result, the ministries wanted to assess four issues/developments and formed working groups to prepare the strategy. Four groups were formed to:

- inventory the relevant international developments;
- determine success factors of international cooperation in procurement;
- determine prior technological areas for defence industry which have an important interest in the domestic market, and,
- policy instruments to strengthen the strategic vision.

The third question on the identification of prior technological areas, was the core issue in this project and divided into four sub questions:

1. What are the current **strengths** of the Dutch defence industry?
2. What are international **opportunities** for innovation in the defence market?
3. Which technologies and innovations meet the future **needs** of the Dutch ministry of Defence?
4. What are opportunities for the **civil market**?

In this approach foresight was embedded into a policy process and used as a tool to provide information for the development of an innovation policy on the defence industry.

Structural Approach Based on Clusters

The challenge of the exercise was to systematically translate the four sub questions into perspectives on technological clusters or innovation opportunities. This makes the outcomes comparable. Every perspective was analysed and then translated into a codified taxonomy of technologies developed by the Western European Armaments Group (WEAG), this WEAG-classification on defence technologies is generally accepted within the defence sector. This taxonomy includes technology, products and intelligence or as they are called 'underpinning technologies', 'systems-related technologies' and 'military assessments, equipment and functions'.

Additionally, the WEAG-classes were checked for interrelation such that priority clusters are formed and interpreted, which seem to combine specific technologies, with products and intelligence. Finally, these priority clusters are compared such that a final reflection is made from the four different perspectives (see figure 1).

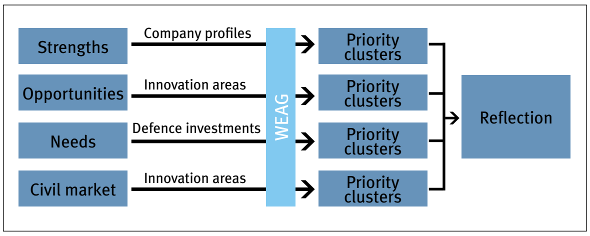


Figure 1: Approach of the study

For determining the **strengths** of the defence industry, companies were analysed and a computer aided workshop with the industry was organized (Group Decision Room). The innovative **opportunities** were inventoried based on desk research and interviews with leading parties. Future **needs** of the military forces were inventoried and weighted based on already planned investments by the ministry of Defence. Finally, the **civil market** was assessed by experts based on most relevant societal challenges.
Below the analysis on current strengths is elaborated. For foresight purposes, also the results on innovative opportunities are included.

Defence Industry Focuses Increasingly on Intelligence

The Defence industry in the Netherlands is relatively small. `With approximately 250 firms, 12,000 employees and 1.5-2.0 billion turnover it represents approximately 0.5% of the Dutch GDP. However, e.g. based on R&D expenditures, it was concluded that the industry was relatively highly innovative sector. The shift towards a traditional civilian sector is already apparent with a large number of ICT firms within the sector and a substantial turnover in civil markets. Partly this shift is inevitable as defence budgets decline, while the internationalisation of the defence market still appears to be hampered by offsets, "Rules of Engagement" and export controls.

Consequently, a nation's defence industry covers all roles in the value chain: research & development, design, engineering, procurement, construction (EPC), subsystem integration, system integration, maintenance, repair and overhaul (MRO) and disposal. However, based on company profiles and questionnaires on WEAG technologies, there is a prioritization (figure 2)

These classes are interrelated; by clustering these classes, technology clusters can be identified. For example, table 2 below shows the classes 'A08 Computing technologies and Mathematical Techniques', 'A09 Information and Signal Processing Technologies', 'B09 Integrated Systems Technology', 'B10 Communication and CIS Related Technologies' and 'C07 Battle space Information form one cluster'.

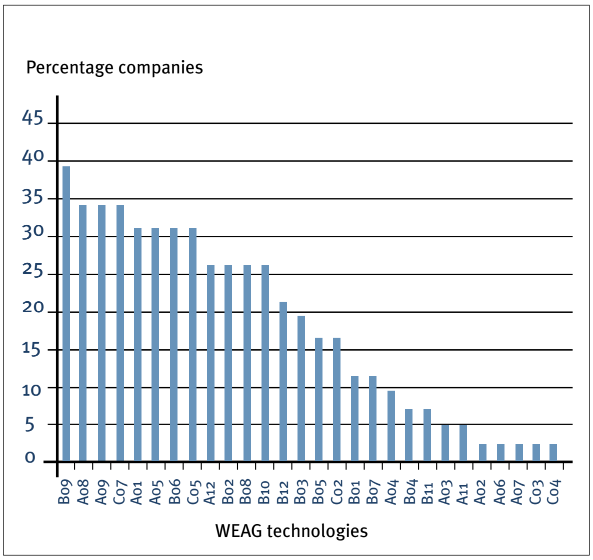


Figure 2: Focus of the Dutch Defence Industry

1	B09 Integrated Systems Technology
2	A08 Computing Technologies & Mathematical Techniques
3	A09 Information and Signal Processing Technology
4	C07 Battlespace Information
5	A01 Structural & Smart Materials and Structural Mechanics
6	A05 Electronic, Electrical & Electromechanical Device Technology
7	B06 Sensor Systems
8	C05 Equipped Personnel
9	A12 Mechanical, Thermal & Fluid-Related Technologies & Devices
10	B02 Propulsion & Powerplants
11	B08 Simulators, Trainers and Synthetic Environments
12	B10 Communications and CIS Related Technologies

Table 1: Most important WEAG classes

	A01	A05	A08	A09	A12	B02	B06	B08	B09	B10	B12	C05	C07
A01	13												
A05		13											
A08			14						+	+			+
A09				14						+			+
A12					11								
B02						11							
B06							13						
B08								11				+	
B09			+						16				
B10										11			
B12											9		
C05								+				13	
C07			+	+						+			14

Table 2: Interrelated classes

Examining the linkages between these classes shows that this cluster is about information processing and analysis. In Defence terminology: Command, Control, Communication, Computers and Intelligence (C4I).

The identified clusters are:

- Command, Control, Communication, Computers and Intelligence (C4I)
- Sensor systems
- Integrated system design and development
- Simulation, training and artificial environments
- Propulsion and energy systems
- Mechanics and hydraulics
- Advanced materials
- Electronics and mechatronics

New Paradigm of Effectiveness

Military operations are increasingly operations other than war such as peace operations, foreign humanitarian assistance and other military support to civil authorities. Consequently, governments turned their focus on the ultimate goal of 'effect-based [security] operations'. In practice, effect-based operations imply a joint and combined cooperation between different armies and forces resulting in a transformation of a platform-centric force into a network-centric force. The term "network-centric warfare" or "network enabled operations" broadly describes the combination of emerging tactics, techniques, and procedures that a fully or even partially networked force can employ to create a decisive advantage. On the whole, the defence sector still innovates on platforms, weaponry and increasingly on intelligence. Figure 3 below shows all innovation themes which are on the agenda of the defence sector.

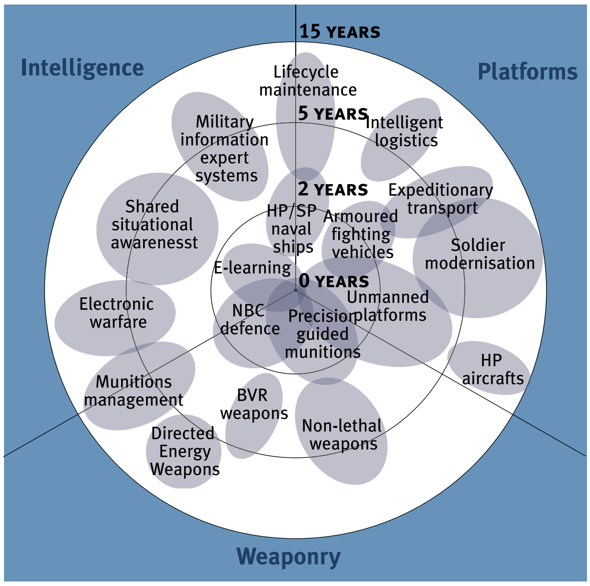


Figure 3: Innovation radar of the (global) defence industry

Innovation themes are divided into underlying innovative opportunities, translated in the WEAG-classification and finally clusters are identified. The main clusters are C4I, sensor systems and integrated system design and development.

Information Based Services

The clusters arising from the four perspectives are compared with each other to identify the main clusters. Table 3 below shows the synthesis.

Type 1 clusters can be regarded as broad, strong clusters, with a good industry base and market potential in domestic, international and civil markets. This first type of cluster represents information based services for the Dutch Industry. Type 2 clusters cover a couple of interesting niche markets. Finally, type 3 clusters are fragmented but might have some niches.

Type 1	C4 I	++	++	++	++
	Sensor systems	+	++	++	++
Type 2	Integrated system design and development	+	+	+	+
	Simulation, training and artificial environments	+	(+)	+	+
	Electronics and mechatronics	(+)	(+)	+	+
	Advances materials	(+)	(+)	+	+
Type 3	Propulsion and energy systems	+	=	(+)	=
	Mechanics and hydraulics	+	=	=	=
	Protection and weaponry	=	=	+	=

++ A broadly represented technology cluster
+ Strong cluster on niches
(+) Potential of cluster has different views
= Less important, fragmented cluster

Table 3: Evaluation of the technology clusters

High Impact on Future Defense Innovation Policy

The project was a highly political trajectory, where the interests of industry and the ministries of Defence and Economic Affairs were intertwined. Also being a part of a broader process and the project delivering the content for just one of four working groups lead to intensive discussions within the interdepartmental group before the results could be used as input to the national strategy on the defence industry. This, together with the change of government, prolonged the finalization of the strategy highly.

About one year after the finalization of the project, the ministries determined their Defence Industry Strategy. The results of the project were largely integrated in the strategy and therefore had a high impact. The technological priorities stated in priorities were fully accepted and provide the backbone to the suggested defence innovation policy. The strategy was discussed in Parliament and will be part of the National Policy on the Defence Industry.

Sources and References

Butter, M, J.H.A. Hoogendoorn, A. Rensma and A. van der Giessen (2006), “The Dutch Defence Outlook”, TNO.

Index of Authors

The European Foresight Monitoring Network

Index of Countries, Regions and Cities

Countries, Regions and Cities — Brief No.

Index of Subjects

Natural Sciences

Engineering and Technology

Medical and Health Sciences

Index of Subjects

Agricultural Sciences

Social Sciences

Humanities

Defense, Safety and Security

European Commission

EUR 23095 EN – The European Foresight Monitoring Network, Collection of EFMN Briefs - Part 1

Luxembourg: Office for Official Publications of the European Communities

2008 — 481 pp. —21.0 x 29.7cm

ISBN 978-92-79-07448-6

KI-NA-23095-EN-C

The European Foresight Monitoring Network (EFMN) is an initiative inspired and financed by the European Commission in the framework of the Foresight Knowledge Sharing Platform. It was started in 2004 as a service to foresight practitioners and policy makers in Europe and beyond. The EFMN approach is based on the continuous process of monitoring and collecting data on foresight exercises conducted not only in Europe, but in other regions of the world as well. This information is collected using experts within the international foresight community. One of the tasks of the network is the production of Foresight briefs. These are short 3-page descriptions of interesting, recent, or ongoing foresight exercises and forward looking studies. The present publication is a collection of the first 120 EFMN briefs that were written between 2004 and 2007. It is a very useful information and dissemination tool addressed not only to the Foresight community but also to policy-makers.

Publications Office
Publications.europa.eu

ISBN 978-92-79-07448-6