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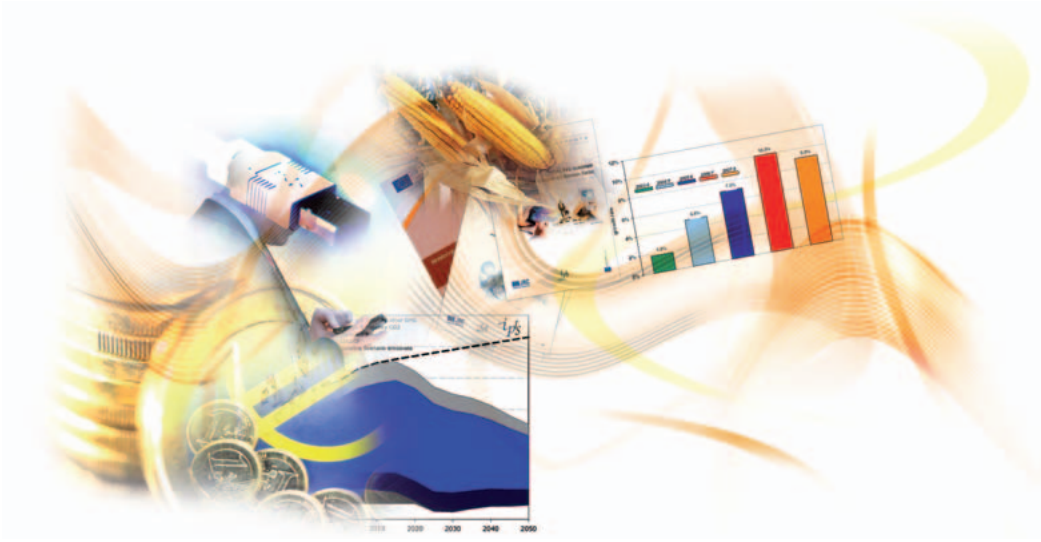
Envisioning Digital Europe 2030:
Scenarios for ICT in Future Governance and Policy Modelling

Authors: Gianluca Misuraca, David Broster, Clara Centeno, Yves Punie, Fenareti Lampathaki, Yannis Charalabidis, Dimitris Askounis, David Osimo, Katarzyna Szkuta, Melanie Bicking

Editors: Gianluca Misuraca and Wainer Lusoli



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European Commission
Joint Research Centre
Institute for Prospective Technological Studies

Contact information
Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)
E-mail: jrc-ipts-secretariat@ec.europa.eu
Tel.: +34 954488318
Fax: +34 954488300

http://ipts.jrc.ec.europa.eu
http://www.jrc.ec.europa.eu

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Scientific Committee Members

Petra Ahrweiler, Innovation Research Unit, University College Dublin, Ireland
Steven Bishop, Global System Dynamics and Policies, Department of Mathematics, University College London, UK
David Chadwick, University of Kent, UK
Bruce Edmonds, Centre for Policy Modelling, Manchester Metropolitan University, UK
Enrico Ferro, Istituto Superiore Mario Boella (ISMB), Italy
Yola Georgiadou, University of Twente, Faculty of Geo-Information Science and Earth Observation – ITC, The Netherlands
Alan Hartman, IBM Research, India
Jörn Kohlhammer, Graphic Information Systems, Department of Realtime Solutions for Simulation and Visual Analytics, Fraunhofer IGD, Germany
Vittorio Loreto, Physics Department, University of Rome 'La Sapienza', Italy
Wainer Lusoli, Information Society Unit, IPTS, JRC - European Commission
Carlo Medaglia, La Sapienza University of Rome, Italy
Ines Mergel, Syracuse University, USA
José Moreno-Jimenez, Multicriteria Decisions Research Group, University of Zaragoza, Spain
Lucio Picci, University of Bologna, Italy
Jeremy Pitt, Institute of Cognitive Sciences and Technologies, Imperial College London, UK
Stefan Steglich, Fraunhofer FOKUS, FAME, Germany
Ljupco Todorovski, University of Ljubljana, Slovenia
Michael Witbrock, CYCORP Inc., USA

1 The CROSSROAD Project is conducted by the consortium composed of: National Technical University of Athens, NTUA (Greece), Tech4i2 Ltd, (UK), University of Koblenz Landau, UKL, (Germany), European Projects and Management Agency, EPMA (Czech Republic) and the European Commission's Joint Research Centre, Institute for Prospective Technological Studies (IPTS) (see www.crossroad-eu.net).

Other External Experts who participated in the CROSSROAD Validation Workshop

Andrea Capocci, Physics Department, University of Rome 'La Sapienza', Italy
Joe Dignan, MICROSOFT Corporation, UK
Thei Geurts, Be Informed B.V., The Netherlands
Anshu N Jain, IBM Research, India
Somya Joshi, Gov2u, Greece
Michael Kaschesky, Bern University of Applied Sciences, Switzerland
Rui Pedro Lourenço, Faculty of Economics, Coimbra University, Portugal
Lanfranco Marasso, Engineering - Ingegneria Informatica S.p.A, Italy
Francesco Molinari, 21c Consultancy Ltd, UK
Kostas Thivaios, INTRASOFT International S.A., Greece
Damir Simunic, WA Research SA, Switzerland
Jeroen Verplanke, University of Twente, Faculty of Geo-Information Science and Earth Observation – ITC, The Netherlands

CROSSROAD Partners who participated in the CROSSROAD Validation Workshop

Dimitris Askounis, National Technical University of Athens (NTUA), Greece
Yannis Charalabidis, National Technical University of Athens (NTUA), Greece
Fenareti Lampathaki, National Technical University of Athens (NTUA), Greece
Irina Zalisova, European Projects and Management Agency (EPMA), Czech Republic
Melanie Bicking, University of Koblenz-Landau, Germany
David Osimo, Tech4i2 Ltd., UK
Stefano Armenia, Tech4i2 Ltd., UK
Katarzyna Szkuta, Tech4i2 Ltd., UK

IPTS Experts who contributed to the CROSSROAD Validation Workshop

David Broster, Head of Information Society Unit, IPTS
Gianluca Misuraca, Information Society Unit, IPTS
Clara Centeno, Information Society Unit, IPTS
Yves Punie, Information Society Unit, IPTS
Cristiano Codagnone, Information Society Unit, IPTS
Stavri Nikolov, Information Society Unit, IPTS
Margherita Bacigalupo, Information Society Unit, IPTS
Esteve Sanz, Information Society Unit, IPTS
Wojciech Szewczyk, Information Society Unit, IPTS

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Preface

This report is the result of research conducted in 2010 by the Information Society Unit of IPTS as part of the CROSSROAD Project – A Participative Roadmap for ICT research on Electronic Governance and Policy Modelling. CROSSROAD links very diverse research disciplines with practitioners' views and policy makers' concerns, through a multi-stakeholder and participatory approach, in order to build a unified vision of the future.

Overall, the research aims to push the boundaries of traditional eGovernment research and help resolve the complex societal challenges Europe is facing by the application of ICT-enabled innovations and collaborative policy modelling approaches, which include the harnessing of collective intelligence, agent-based modelling, visual analytics and simulation, just to mention a few.

Innovation, sustainability, economic recovery and growth will in fact depend more and more on the ability of policy makers to envision clearly and effectively both the root causes and the possible solutions to complex, globalised issues.

This research sets out to help policy makers implement the Digital Agenda for Europe, the flagship initiative of the EU2020 strategy that aims to increase growth and competitiveness of the EU in the fast evolving global landscape, and address the grand challenges our world is confronted with today. In this report, we look at the future of ICT-enabled governance and develop a vision of the role of ICT research in shaping a digital European society in 2030 through four thought-provoking visionary scenarios.

These scenarios are of strategic importance because they help us to foresee how European society could become twenty years from now, thanks to advances in ICT for governance and policy modelling. The scenarios, their formulation and interpretation, expose the gaps there are today in research and what needs to be addressed in order to enable better governance and construct a more open, innovative and inclusive digital Europe tomorrow. In other words, it helps shape the contours of a desirable future - with two important caveats: not all possible futures are equally desirable; and not all ICT developments assist all possible futures. With this in mind, now is the time to design together the future of Europe.

I wish you pleasant reading.

David Broster
Head of the Information Society Unit, IPTS

Executive Summary

Today's Internet is a remarkable catalyst for creativity, collaboration and innovation providing opportunities that would have been impossible to imagine just two decades ago. If one had predicted then that, in 2010, children would freely access satellite images of any place on earth, interact with people from everywhere and search trillions of data with a simple click on their PCs, one would have been taken for fool.

This report sets out to prepare a similar excursion into the future, by outlining a set of scenarios on how governance and policy modelling, supported and enhanced by the use of Information and Communication Technologies (ICTs), could develop by 2030 in order to identify the research needs and policy challenges to be addressed. These efforts may also help the fool sound wise twenty years from now.

The scenarios were developed by means of narration (storytelling) of possible future outcomes in selected key domains of European society where the development of ICT tools for governance and policy modelling are likely to have a major (positive or negative) impact. As an addition to each scenario, 'storyboards' (short narrative representations of scenarios) are used to exemplify situations in which users may find themselves if scenario conditions are realised.

The study thus draws a framework for analysis of current and future challenges in ICT for governance and policy modelling. The scenarios are internally consistent views of what the European governance and policy making system could become by 2030 and of what the resulting implications for citizens, business and public services would be. The uncertainties underlying the scenario design are: 1) the societal value system we will be living in (more inclusive, open and transparent or exclusive, fractured and restrictive), and 2) the response (partial or complete, proactive or reactive) to the acquisition and integration of policy intelligence techniques in support of data processing, modelling, visualization and simulation for evidence-based policy making.

Accordingly, the key impact dimensions were classified on two axes: **Openness and Transparency and Integrated Policy Intelligence.** The following four scenarios were defined according to their positions on the two axes of the scenario design framework:

1) **Open governance:** characterised by high openness and transparency and high integration in policy intelligence;

2) **Leviathan governance:** characterised by low openness and transparency and high integration in policy intelligence;

3) **Privatised governance:** characterised by low openness and transparency and low integration in policy intelligence;

4) **Self-service governance:** characterised by high openness and transparency and low integration in policy intelligence.

In the **Open Governance Scenario**, users will enjoy unprecedented access to information and knowledge. By shifting cognitive capacities, the work of memorizing and processing data and information will be passed onto machines, while humans will focus on critical thinking and developing new analytical skills. This will enhance collective intelligence (both human and ICT-enabled). Humans will be able to use policy modelling techniques to help solve global challenges. Possibilities for the provision of personalized and real-time public services

will be opened up. The online engagement of citizens and various governance stakeholders will increase. Citizens, businesses and researchers will have direct access to data they need and this will create new opportunities for people to interact with and influence governance and policy-making processes and make progress in solving societal problems. Governance processes and policy-making mechanisms will be based on ICT-enabled simulation and visualization intelligent systems, able to find meaning in confusion and solve novel problems, independently of human-acquired knowledge. New, open ways of producing and sharing knowledge will radically change traditional governance processes and decision-making mechanisms. This will herald an era of open innovation, with unimagined opportunities for research and technological development. Public, private and third sector institutions will start to listen more carefully to their stakeholders, and a sort of 'molecular democracy' will arise.

The **Leviathan Governance Scenario** assumes that an 'enlightened oligarchy' will emerge that uses high-tech tools and systems to collect and manage public information and services. Judgment and decision-making will be based on analytical processing of factual information from the many by the few for the benefit of all. Full-scale 3D automatic simulations and policy intelligence tools will facilitate decision-making and the oligarchs will simply approve the recommendations of these tools for the best policy option for the majority of citizens. 'Real-time governance' will be possible, where the government/citizen relationship is under total control. Public service delivery will be personalized without people having to ask, thus saving a great deal of time. In this context, citizens will trust the government and will be willing to delegate their right of initiative. Generally, they will be persuaded to be happy with this situation, as no human-caused problems will exist; emotions and thoughts will be controlled and directed towards the public good. However, citizens will be passive recipients of decisions taken by information systems; choice will be restricted by predefined and pre-calculated algorithms that optimize people's performance from the cradle to the grave. No active participation by citizens in everyday decision-making will be required or sought. In this scenario, circulation within Europe and across its borders will have been greatly limited. Information overload or potential failure of information systems to respond to critical, unforeseen situations would result in chaos, with humans and devices not knowing how to respond.

In the **Privatised Governance Scenario**, society will be shaped by decisions taken by corporate business representatives. Discussion on social issues and about the role and behaviour of citizens will be muted, as people will be pawns whose needs and desires are managed by large corporations. Interactive and participatory governance mechanisms will be sidelined, along with democracy as we know it today. Decision making will depend on ICT. ICT-enabled modelling and decision-support systems will be highly developed by individual companies but not necessarily integrated. Simulations based on data gathered by sensors and collected from continuous monitoring and analysing networks, businesses, customers and the environment will produce global information that will still be fragmented and owned by corporations. Systems will be threatened by frequent attacks from independent groups and dissident communities. It will, however, be possible to prevent these attacks by the deployment of ICT systems able to forecast cyber attacks by running social simulations. The media will be owned by the large corporations and will generally support them. Misinformation and jamming campaigns will be launched, making it necessary to verify all information and data. In this scenario, there will be opportunities for high innovation and development due to the pressure of competition on a free market in areas such as telework and telemedicine, early warning systems to avoid global pandemics and disaster management assisted by real-time decision support systems. These will be very

useful for the limited number of users able to afford them. Risks will arise due to private interest and fragmentation of the public good; especially, as regards the use of ICT for health, education, energy efficiency, environmental protection and prevention of natural disasters. This will lead to a fragmented society where social welfare services will not be guaranteed to all, thus exacerbating possible social tensions and conflicts.

The **Self-Service Governance Scenario** envisages a society where citizens will be empowered to play the role of policy makers. In small expert communities, citizens will devise policies in accordance with the do-it-yourself principle; they will choose from a menu of public services those they need and consent to. This ICT-enabled, self-organised society will be able to address emerging problems faster than traditional government could. Its creative, contextual solutions could prove more robust and resilient in a crisis. Nevertheless, the diversity of opinions between discrete communities may result in the deepening of existing divides and a lack of social cohesion. Insularity will afflict migrant and ethnic minorities most severely, as they lack local social networks and may run into communication problems due to language and cultural differences. However, thanks to efficient translation tools, the dissipative communities may in the end create a vibrant cross-cultural and multi-language society. The difference between success and failure will be marked by the distinction between effective and creative group thinking and 'crowd stupidity' and lack of knowledge transfer. The process of gradual disappearance of institutions and lack of trust in government will result in the need for new trust providers. Reputation management, for content and people, will play a significant role in service provision. People's identities will be made up of different layers shared with different groups and individuals on a case-by-case basis. Authentication will be granted by communities, which may hinder the transferability of trust across people and groups. As the majority of citizens will not be interested in participating in governance due to the lack of engagement culture, new Caesars may emerge who unify disparate groups but damage the subtle equilibrium between self-serving and collaborative cultures.

In all the scenarios, the world in 2030 will be radically different from today's, due to the unprecedented growth and speed of ICT uptake in several fields (e.g. social computing, mobile technologies, pervasive computing) and the related enabling applications of ICT for governance and policy modelling. Four main trends of change in governance and policy-making, are identified:

- There will be a growing awareness by governance actors of citizens', businesses', and administrations' needs and wishes for more choice. Governance actors will address user involvement and set up new processes of engaging with users. They will treat users in a new way that acknowledges their skills and their skills needs, and that matches their growing role. The principles of facilitating more participation, user-created content, user engagement and ownership of public services will affect governance and policy-making mechanisms.

- Novel governance models will emerge, which introduce principles of efficiency, effectiveness, quality assurance and evaluation, and directly lead to evidence-based policy as a necessity for making informed decisions. This trend is related to dwindling public finances, the search for novel propositions that ensure value for money, quality in service delivery and efficient and effective organisation of public administration by means of interoperability and greater economies of scale at regional, national and pan-European levels.

- The digitisation of services, processes and interactions is expected to continue and become pervasive. This will lead to disruptive effects on life in general and on governance and policy making in particular. ICT policy

agendas in most European countries are consistent in their emphasis on the need to fundamentally redesign governance processes and policy-making mechanisms.

- In the longer term, governments will embrace more 'networked-governance' structures. However, a struggle will unfold between traditional bureaucratic systems and network-based mechanisms as to which is the best way to organize people, knowledge and service delivery. Changes in governance structures and processes may well occur in phases, in response to the pressures applied by new ICT tools and emerging societal behaviours.

The report also examines the underlying risks and opportunities in each scenario, in order to identify the key research requirements in ICT for governance and policy modelling that could fulfil the potential and prevent the threats. The opportunities offered by ICT tools for governance and policy modelling will only be reaped if appropriate conditions and 'governance models' are set. Changes in information patterns and data processing will have implications for organizational structures and for the way decisions are made, operations are managed and processes are conceived. It is expected that ICT tools for governance and policy modelling will force change in institutions despite their resistance. While governments that redefine their relationship with their stakeholders will be the ones that succeed, the market will still drive that process in the commercial domain. Tensions may emerge as stakeholders know more and more about the organizations that are trying to serve them.

The report also indicates that technical and policy challenges must be tackled if the benefits of ICT solutions for governance and policy modelling are to be fully realised.

- Early adopters will need to prove that tools and applications support innovative business models and create public value.

- Government regulators and industry groups should strengthen data privacy and security, particularly for uses that touch on sensitive data belonging to citizens and government.

- Governments and industries, with the support of risk analysts, should devise legal liability frameworks for eventual wrongs generated by automated systems.

- The cost of such applications must fall to a level that sparks widespread adoption. Networking technologies and the standards supporting them must evolve to the point where data can flow freely and with minimum friction among real and virtual environments.

Future research in the following areas may help to harness the potential of ICT for governance and policy modelling:

- Information management and analysis, to monitor and simulate in real time the behaviour of real and virtual entities (persons, things, information and data).

- Enhanced real-time situational awareness for tracking, policy modelling, and visualisation.

- Policy intelligence and ICT-driven decision analytics.

- Automated mass collaboration platforms and real-time opinion visualisation.

- ICT-enabled data and process optimisation and control.

- Complex dynamic societal modelling systems.

Altogether, increasing demand for openness, transparency and collaboration will also drive the emergence of 'experimentally-driven research'. This will address broad governance and policy-making challenges, developing and applying ICT tools and applications that fully exploit the potential of mass collaboration and the open and participatory paradigm underpinning future technological developments and policy directions in Europe.

This will eventually allow the implementation of new ICT-based solutions and models for collaborative governance and integrated policy modelling mechanisms, and permit socio-economic impact assessment of societal changes. Policy makers should build on the momentum that ICT for governance and policy modelling has recently gained.

In order to bridge the gap between various stakeholders, long-term research and large-scale experimentation, enabling cross-fertilization across different scientific disciplines and integration of resources, special emphasis should be put on fostering common research results.

Research and innovation investment in this domain could create value for the EU community and avoid fragmentation of research efforts (it will also include the experiences gained at the international level). It will require the development of a joint strategic research agenda on ICT for governance and policy modelling to support the building of an open, innovative and inclusive Digital Europe 2030.

1. Introduction

1.1 Purpose and scope

According to the European Commission's Seventh Framework Programme (2009-2010), ICT for governance and policy modelling combines two complementary research fields that have traditionally been separated: the governance and participation toolbox (technologies such as mass conversation and collaboration tools); and the policy modelling domain (forecasting, agent-based modelling, simulation and visualisation). These ICT tools for governance and policy modelling aim to improve public decision-making in an age of complexity, make policy-making and governance more effective and more intelligent and accelerate learning in the policy cycle.

The main question asked in this report is: taking into account the fact that possible future scenarios may be radically different, what are the future needs for ICT tools for governance and policy modelling?

To answer this question, an analysis of future needs, risks and opportunities in different scenarios was carried out and a set of scenarios on how governance and policy modelling could have developed by 2030 was designed. The scenario building exercise resulted into four alternative exploratory scenarios and a set of scenario storyboards constructed interactively with experts.

The report builds on work conducted by the CROSSROAD Project, specifically on a research area taxonomy that classifies research in ICT for governance and policy modelling into 5 main themes:[2] 1. Open government information and intelligence for transparency; 2. Social computing, citizen engagement and inclusion; 3. Policy making; 4. Identity management and trust in governance; and 5. Future internet for collaborative governance, [CROSSROAD, 2010a].

1.2 Why scenario building?

Reasons to develop forward-looking analysis to support policy decisions stem primarily from the emergence of important science and technology applications and their wider implications for society. Science and technology interact with society in a complex way and their 'effects' are often neither immediate not direct, but of second or third order and occur after a substantial time delay [EC, JRC-IPTS, ESTO, 2001]. Specifically, technological developments in the domain of ICT for governance and policy modelling happen at a fast pace. Policy-makers cannot afford to wait until situations are clarified and until the effects are evident before they take decisions. Though tomorrow's developments are uncertain they originate in conditions established today. Hence, there is an important need for policy-makers to scope the impacts of science and technology and their possible future developments.

With regard to methods, the history of forward-looking analysis and future studies spans decades. Three areas of future-oriented technology analysis can be identified: technology forecasting analyses the conditions and potential of technological development within a concrete framework; technology assessment supports decision-making by generating technology or problem-specific options arising from new developments; technology foresight addresses the impacts of technological development on a broader scale [EC, JRC-IPTS, ESTO, 2001].

2 CROSSROAD, (2010a), Deliverable 1.2, State of the Art Analysis, (available at www.crossroad-eu.net).

Technology forecasting consists of continuous monitoring of technological developments and their conditions, leading to early identification of promising future applications and an assessment of their potential. Decision makers are assisted by a three-step process (identification – validation – information transfer and implementation) in a concrete technological framework. This process takes broad technological developments and socio-economic aspects into account, but does not analyse them in detail.

The results of technology assessment support decision-making on technology through analysis of the social, economic and environmental potential of new scientific and technological developments. This includes their impacts and framework conditions. Technology assessments focus on either a specific technology (technology-driven) or on societal problems arising from the application of a technology (problem-driven).

However useful these two methods may be, the growing knowledge-intensity, the pace of technological and societal changes and the increasingly distributed and networked character of the economy and of governance processes cannot be explored using only technology-oriented future studies. This requires a more comprehensive approach. In fact, designing scenarios relies on foresight methods, which are based on a much broader concept. It calls upon a wide range of themes and stakeholders perspectives, in order to examine the social and economic aspects of future technological developments. The process is interactive, open-ended and bottom-up and paves the way to identifying possible breakthroughs and exploring implications and hypotheses that will support the definition of strategic directions and policy-related decision-making.

Therefore, the methodological approach adopted in conducting the scenario analysis is based on a foresight exercise and included the following activities:

- Analysis of the key areas of expected change where ICT for governance and policy modelling research is likely to have a significant impact on the public sector and on society, in different future scenarios.

- Envisioning the risks and opportunities offered by ICT for governance and policy modelling in each scenario, with respect to their contribution to overall EU policy goals as described in the EU2020 strategy and particularly in relation with the European Digital Agenda, [European Commission, 2010b].

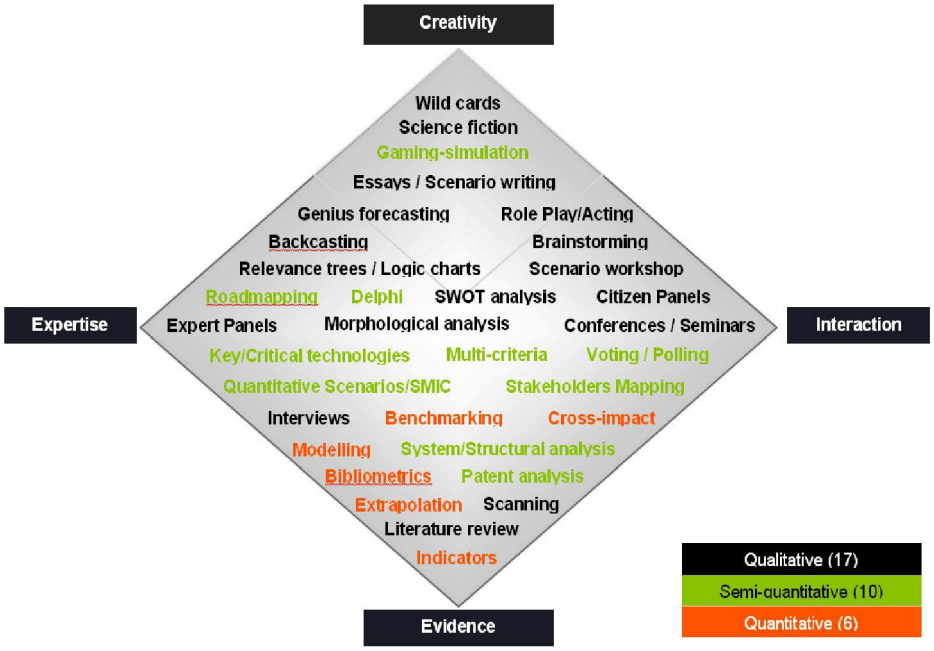
With regard to the conceptual framework informing scenario design, different methods of foresight research are available. The foresight objectives, and the degree of uncertainty and complexity involved, guides the selection of methods for a particular exercise. According to Popper [2008],[3] these methods can be categorized by their essence (expert-based, creativity-based, interaction-based or evidence-based) (Figure 1.1.).

For this study, we settled for scenario design which aimed to explore possible alternative futures in ICT for governance and policy modelling research and to elaborate on the possible impacts (in terms of both opportunities and risks) that future mainstreaming of ICT tools in this domain may have.

A scenario is meant to be a systematic vision of future possibilities [Miles, 2003]. In foresight research, these possibilities should be plausible and should not rely too much on wild cards. They are used as tools for political or strategic decision making and to explore the impact of particular decisions or developments in the future [Janseen et al, 2007]. More specifically, scenario building aims to identify

3 Popper also makes a distinction between a methods' orientation (normative or exploratory) and its nature (quantitative or qualitative) [Popper, 2008].

Figure 1-1: Foresight methods classified by their essence



Source: Popper, 2008.

uncertain developments in the future and take those uncertainties as elements of the scenario narrative [Van der Duin, Huiboom, 2008]. The time horizon of this exercise (i.e., 2030) and the interrelationships between different developments affecting it (rapid developments in specific domains of ICTs) make the future of this domain of research dynamic, complex and uncertain. Moreover, there is little available evidence that can be used to predict or forecast these futures. It is difficult to use quantitative and evidence-based methods. Courtney et al. describe this uncertainty as 'level 3', at which a range of different possible futures can be identified [Courtney, Kirkland, Viguerie, 1997]. They describe three types of foresight methods that can be used at this level: scenario writing, backcasting and early warning systems. As the latter two approaches are often incorporated into scenario writing, the method of scenario design was used in this exercise.[4]

Figure 1.1 shows that the scenario design adopted as part of this foresight exercise is: 1) evidence-based, as it builds on the trends emerging from a policy review and trends analysis and the assessment of state-of–the-art research in ICT for governance and policy modelling; 2) expertise-based, as it includes the views of experts gathered through a call for expert contributions and further discussion held during an Expert Workshop to validate the scenario design framework; 3) interactive, as it incorporates the inputs from the Expert Workshop and from online public consultation; and 4) creative, as it is based on the 'creative-thinking' that came out of a series of brainstorming activities by members of the lead team of IPTS and CROSSROAD partners.

The scenario building followed a common 5-step methodology: 1) a trend analysis to determine the developments that could be key drivers for the future of ICT for governance and policy modelling, 2) the selection of the scenarios by determining the main impact dimensions and key uncertainties, 3) writing of the scenarios, 4) identification of the implications of the scenarios by participants at the Validation Workshop and by

4 Scenario writing is a method that is commonly used in research regarding public services and eGovernment, i.e. [Aicholzer, 2005], [Janssen et al., 2007], [van der Duin, Huijboom, 2008].

consulting the public and 5) deriving conclusions for policy implications and research challenges [EC, JRC-IPTS, FOR-LEARN,2010].

More specifically, the following activities were conducted:

- Data-mining of the CROSSROAD knowledge base (resulting from the analysis of the state of the art),[5] including mapping and analysis of the state of the art and trends in research on ICT for governance and policy modelling.

- Identification of emerging research trends, based on preliminary results of relevant FP7 projects and their usage for future implementations. This scanning activity allowed us to identify the main impact dimensions which are likely to influence research directions in ICT for governance and policy modelling in the future.

- Refinement of the impact dimensions identified, taking existing scenario exercises and emerging trends into account, and then used for the construction of the scenario description framework.

- Development of the chosen impact dimensions into alternative scenarios highlighting how their main features interact within possible states of the future at horizon 2030. This entailed:

- defining the main characteristics of scenarios;

- drafting a scenario description framework explaining the interactions between these features in specific key societal domains;

- analyzing the implications of scenarios in terms of risks and opportunities, to form the basis of a discussion on both the desirability and likelihood of these possible futures in 2030;

- discussing the findings and the draft scenarios in a Validation Workshop and in public consultation to receive feedback and validate the proposed visions and scenarios;

- updating the scenarios by incorporating comments and refining the findings in order to ensure that they encompass all dimensions related to the broad domain of ICT for governance and policy modelling.

To take the scenarios further, we then developed 'storyboards' (narrative representations of scenarios, similar to those used in film-making). While scenarios convey a shared vision and understanding of how the future could develop, storyboards show intuitively the situation in which users may find themselves if the conditions imagined are realised and what could be offered or provided in such circumstances.

During the Validation Workshop, participants were divided into four working groups, each assigned to one scenario. After brainstorming on those ICT tools that may be mainstream in 2030, these were applied to the specific societal challenges proposed in each scenario.

The main societal challenges proposed for 'case study discussion' were a) financial crisis (e.g. following the Greek collapse, other countries require support from international financing Institutions); b) climate change (e.g. oil and water depletion require the allocation of limited resources among EU population); c) a new global pandemic (e.g. the spread all over Europe of an unknown virus from Asia); d) urban transport sustainability (e.g. traffic congestion in cities could mean that the movement of personal vehicles has to be limited; e) environmental emergency (e.g. a volcanic eruption spreads a cloud of ash all over Europe); and f) massive migration flows (e.g. desertification of Sub-Saharan Africa and glaciation of Northern Europe

5 See CROSSROAD, Deliverable 1.2, State of the Art Analysis (available at www.crossroad-eu.net).

lead to massive migration flows towards Southern Europe and North Africa).

Participants in the working groups were asked to envision the future in a systematic and structured way, and extend the scenarios beyond the current state of the art by projecting possible research and technological developments in the next 20 years and imagining their impact on the European society, with specific regard to how these will affect governance processes and policy making mechanisms.

The expected outcome of the exercise was twofold: a) the development of scenario storyboards for some of the societal challenges proposed; b) the identification of research needs for these application scenarios to become reality at the horizon 2030, taking into consideration risks and opportunities linked to them.

In this regard, it must be underlined that the scenario design exercise conducted is instrumental to further developing the CROSSROAD Roadmap on future research in ICT for governance and policy modelling. This roadmap is the final outcome of the CROSSROAD project, to be achieved in a participatory manner after completing a fully-fledged gap analysis.[6]

The ultimate objective of the scenario exercise is also to respond to another important CROSSROAD goal: to develop a shared vision among representatives from academia, business, civil society and government, which will inspire collaborative and interdisciplinary research.

1.3 Structure of the report

Section 1 outlines the purpose and scope of the report and the methodological approach followed.

Section 2 presents a trends analysis based on the main existing scenarios and future visions of society and policy for ICT for governance and policy modelling, on the main findings resulting from the analysis of the state of the art of the domain,[7] on experts' views, on material made available through the call for contributions and on analysis of the current status of other FP7 projects in the domain.

Section 3 illustrates the scenario design framework and the scenarios for 2030, including the storyboards developed and the prospective opportunities and risks identified for each of them.

Section 4 draws conclusions and presents the proposed shared vision for a Digital Europe 2030, and also offers a summary of the main elements to be considered as an input for the future development of the research roadmap for ICT for governance and policy modelling.

6 See www.crossroad-eu.net

7 See CROSSROAD, Deliverable 1.2, State of the Art Analysis (available at www.crossroad-eu.net).

2. Trends Analysis

In this section, we present a general overview of the societal and policy trends that are considered central for understanding and mapping ICT research for governance and policy modelling in the future. We discuss briefly the main findings of the analysis of the main emerging trends identified through a detailed review of state–of-the-art research as part of CROSSROAD, selected normative visions proposed by experts in their position papers submitted to the call for contributions, and a preliminary overview of the forthcoming research trends in current FP7-funded projects.[8]

The material analysed includes policy reports and studies on future research and policy visions, (mainly at EU-level, but also international studies). National policies from EU Member States and from countries considered to be trend leaders were also considered, as these policies and directions could be useful for understanding the value and development of future directions in the broad domain under investigation.[9]

2.1 Societal trends

In order to formulate a set of key uncertain developments that may drive the future of ICT for governance and policy modelling, we conducted an analysis of main societal trends based on the previous research of IPTS [EC, JRC-IPTS, 2009b, c, d]. This trend analysis covers 6 main categories: social, technological, economic, ecological and public values, often abbreviated as STEEPV. The analysis includes an overview of stable and more uncertain trends (such as climate change, ageing and others) to provide the context for the scenarios.

Around 30 foresight studies, policy reports and scenarios were included, chosen because they involved ICT developments and involved governance and related policy-making issues. As most studies distinguished between relatively stable and uncertain trends, they were extracted accordingly. From the review, about 30 relatively stable developments and about 40 uncertain developments were identified. For studies in which this distinction was less clear, the judgement was made based on comparison of trends and grouping of the similarities found [EC, JRC-IPTS, 2009b].

Both stable and uncertain trends were grouped into a total of 11 'clusters of influence' [EC, JRC-IPTS, 2009d]: 4 clusters of relatively stable developments and 7 clusters of uncertain developments. For stable developments, broad categories of 'technological', 'socio-demographic', 'environmental' and 'economic' trends were found. For uncertain developments, these categories were too broad and needed more refinement. For these, emerging trends were further analysed in order to find common or shared properties on a higher level of abstraction [EC, JRC-IPTS, 2009b].

Tables 2.1 and 2.2 present respectively the clustering of stable and uncertain trends which are then also briefly described in the text.

8 Details of the analysis are presented in the Annex C and D to the Deliverable D.2.2 of the CROSSROAD Project – Visionary Scenarios Design (available at www.crossroad-eu.net).

9 The review was conducted combining meta-analysis and narrative review (two common methods for policy review and trends analysis), with a focus on snapshots and 'contextual' overviews of what can be identified as the key trends and areas of expected change.

Stable trends

Table 2-1: Clustering of key stable trends

Clusters	Trends
Technological trends	Technological growth and turbulence
	Technological standardisation in interface of eGovernment systems
	Virtualisation
	Miniaturization and portability of ICT
	Ambient intelligence
	Growing collection of data, use of sensors for monitoring
	Internet of things
	Use of open source software
	Increasing interoperability of eGovernment systems
	Broadband adoption
	Fragmentation and separation of networks and applications
Socio-demographic trends	Population growth
	Ageing
	Immigration and increased mobility
	Urbanisation / Deterritorialisation
	Diversity in culture and religion
	Individualization (e.g. smaller households, voluntary families, shared households, etc.)
	Lifelong learning
	Horizontalisation
Environmental trends	Global warming
	Rising energy demands / changing of 'energy-mixes'
	Increased citizen awareness and media attention
Economic trends	Lowering of GDP trajectory in the EU
	Permanent loss of skills due to protracted unemployment
	Lower investment in equipment, infrastructures and R&D which hampers Europe's innovation potential
	Strengthening of 'vertical' and 'horizontal' coordination

Technological trends

Most of the studies reviewed mention that technological growth will continue in the future. This growth has disruptive potential: technology will develop faster than organisations and society can keep up with. Broadband Internet will be widely adopted across Europe. The continuing process of miniaturization will make many products smaller and more portable: mobile ICT will become more important and provide the basis for ambient intelligence and ubiquitous computing [EC, ISTAG, 2001]. Virtualisation and the use of sensor monitoring technology will increase the production of data concerning our everyday lives; like ambient intelligence and ubiquitous computing, these trends will require a mixture of safeguards [EC, JRC-IPTS, 2006a, 2006b]. The rise of advanced data analysis and artificial intelligence will be partly driven by information overload, creating a crisis in information management and the effort to advance data mining. In parallel, a field called 'visual analytics' has emerged as a multidisciplinary combination of information visualization and data mining which will enable effective, user-centred analysis of very large amounts of data and information [Thomas, Cook, 2005]. Although these developments will happen, when is very uncertain. Ambient intelligence is therefore described as both a certain and an uncertain trend [EC, ISTAG, 2001]. Fragmentation is also seen as an important trend, at the level of the Internet as a network (there will be different smaller, local

networks that are not necessarily interconnected) and at the level of usage [EC, JRC-IPTS, 2008]. In the public sector, the usage of open source software and the interoperability of eGovernment systems will increase, although it is not clear to what level of importance.

Socio-demographic trends

In the future, bar disaster, the world population will keep growing and urbanisation will result in large metropolises. In Europe, the average age of inhabitants will rise. This ageing process has social and economic implications, and may also shift the centre of innovation to younger societies [EC, JRC-IPTS, 2009b]. Globalisation will continue to drive global migration and increase mobility in general. A related trend is deterritorialisation: ties between culture and place are likely to weaken. Drastic environmental changes in the future may also result in climate refugees. However, some cultural ties will prove to be sticky, as people will need to be mobile in order to access these.

Organisations and societal groups will be structured more horizontally than vertically. Several studies identify a continuing trend of diversity in culture and religion. The current trend of individualization (e.g. smaller households) and personalisation is expected to continue, impacting the public sector. For example, people will pursue personalised 'lifelong learning' throughout their lives [EC, JRC-IPTS, 2009c]. In addition, the number of voluntary families (i.e. not based on kin relations) is also expected to increase, resulting in households being shared on the basis of common values and interests; multiple monogamy processes will result in individuals having more than one family in a lifetime.

Environmental trends

Three major trends were found in the environmental trends cluster. Worldwide energy demand will grow as the population grows. The growth in energy consumption will reinforce global warming. However, recent natural disasters and continuing attention paid by the media to climate change will raise citizen awareness of current and future environmental threats and of the risks associated with them if no immediate action is taken. If unaddressed by 2030, the energy situation in Europe will be one of increasing need and declining supply [EC, JRC-IPTS, 2009c]. Dependency on expensive oil, gas and coal imported from third countries will increase from its current 50% to about 60%, while fossil fuel energy could supply up to 80% of Europe's demand. Furthermore, supplies will be drawn from some of the world's most politically volatile areas [EU, 2010]. While in the near future it will still be unclear how social action for and policy attention to global warming will impact on the environment in the long-term, it is expected that citizen awareness and media attention will play an important role in increasing the visibility of the debate and forcing political responses at European and global level.

Economic trends

The global financial crisis which began in the summer of 2007 is the most serious since the Great Depression in the 1930s. European real GDP fell about 4% in 2009, the sharpest contraction in EU history [EC, 2009a]. Although signs of recovery have appeared, they are uncertain and fragile. The EU's response to the downturn was swift and decisive, and aimed to stabilise and reform the banking sector. Launched in December 2008, the European Economic Recovery Plan (EERP) aimed to restore confidence and bolster demand through a coordinated injection of purchasing power into the economy, complemented by strategic investments and measures to shore up business and labour markets. The overall fiscal stimulus, including the effects of automatic stabilisers, amounts to 5% of EU GDP. However, unless policies take up the new challenges, GDP in the EU could fall to a permanently lower plateau, due to 1) protracted spells of unemployment in the workforce and related permanent loss of skills; 2) infrastructure equipment stock decrease and obsolescence due to lower investment; 3)

sluggish innovation as R&D spending is one of the first to be cut back by businesses in a crisis. The Member States implemented a range of measures to provide temporary support to labour markets, boost investment in public infrastructure and support companies and financial institutions. Strengthening 'vertical' coordination between various strands of economic policy (fiscal, structural, financial) will ensure that the withdrawal of government measures is properly sequenced - an important consideration as turning points may differ across policy areas; while 'horizontal' coordination between Member States will help them to avoid or manage cross-border economic spill over effects, benefit from shared learning and leverage relationships with the outside world.

Uncertain trends

Table 2-2: Clustering of key uncertain trends

Cluster	Trends
Degree of social cohesion and inclusion	Community spirit vs. individualism / Community bonding vs. bridging (Political, social, religious) (in)stability Digital divide vs. inclusion Social exclusion and polarisation Interest group politics Intergenerational tensions Homogeneous EU culture vs. diversity EU-citizenship Regionalisation vs. EU integration Cooperation vs. non-cooperation between EU Member States
Citizens' attitudes towards government	Political interest of citizens Political engagement of citizens Idealism vs. pragmatism
Scope of government	Power of government / EU Degree of government intervention Degree of privatisation of public services Degree of (de-)centralisation of government tasks Demand for greater transparency of financial and economic institutions
Innovation	Ambient intelligence Use of biometry Convergence of NBIC technologies (Nanotechnology, Biotechnology, ICTs and Cognitive Science) Applications for web 2, web 3
Citizens' attitudes towards privacy	Acceptance of monitoring and surveillance trends Individual control over digital identities Constructed Identity
Economic growth	Prosperity of economy Collapse of shareholder wealth EU competitive performance
Sustainability	Consideration for sustainable development Greening of government Shift towards renewable energies Increased attention on environmental protection and responses to natural disasters 'Public' responsibility for environmental catastrophes

Social cohesion and inclusion

A number of uncertain developments concerning the degree of social cohesion and inclusiveness in the European society were identified and grouped. While there is speculation about an increasing separation between digital literates and illiterates, new Internet-based and collaborative technologies are likely to enable the inclusion of groups that otherwise would be excluded (e.g. people with disabilities or living in remote areas). ICT and cognitive enhancement may promote inclusion of the elderly and those with learning disorders. The rise of 'niche' or 'interest group' politics may continue, polarising different socio-political groups in society. However, future developments in collaborative ICTs may also enhance communities by bridging between large groups in society, eventually strengthening cohesion. At the European level, it is uncertain whether Member States will increasingly cooperate and act in harmony, or whether there will be a trend towards increasing regionalisation (or fragmentation along other dimensions – or of nation-states themselves). However, there are risks of reinforcing 'intellectual isolation' (i.e. people find like-minded others and engage in a discourse which simply reinforces their original opinions and stereotypes). In addition, the effective organisation of 'interest groups' via the Internet may also enhance existing advantages with respect to other groups, thus making society less inclusive [Rethemeyer, 2006, 2007].

Citizens' attitudes towards government

There are a number of trends concerning the interest and involvement of citizens with the political decision making process. In this regard, a specific though uncertain trend concerns the increasing attention citizens and media place in the management of financial and economic affairs, due to the financial crisis and the effects it has had on the European economy. This results in pressure on governments and in demand for greater transparency of financial and economic institutions. While developments regarding the degree of political engagement of citizens are very uncertain, it is expected that the possibilities offered by collaborative technologies for 'sousveillance' and citizens' control over political action will increase and in turn produce pressure to enhance accountability and transparency of policy makers and governance stakeholders [EC, JRC-IPTS, 2009a, 2009b].

Scope of government

A number of questions regard the power of the Member States and of the EU in the future. The role of government is undergoing continuous change, which appears to have accelerated in the last few years mainly because of the widespread adoption of ICTs in conjunction with the growing processes of state liberalization and economic globalization. [EC, JRC-IPTS, 2009b] Government action is increasingly under pressure from the need to re-design governments' roles in areas where they were directly involved in service provision, such as utilities, education and health. On the other hand, this trend is now affected by the financial crisis and some failures of privatization, as well as by the emergence of alternative approaches in emerging countries, in particular in the BRICS group, and a mixed approach in the USA. Thus it is unclear if the delegation of service provision will continue, take a different shape or be strengthened by ICT advancement. Similarly, it is uncertain whether governments will further decentralise particular activities and public services or whether European integration will instead promote a more centralised system with increased executive power.

Innovation

Although a number of technological trends can be identified, such as the convergence between nanotechnology, biotechnology, ICTs and cognitive science (referred to as NBIC convergence), the speed of these developments remains unclear. In Europe, both in Member

States and at EU level, research and innovation systems are seen to require policy interventions designed to improve their performance.[10] Often, broad trends in technological capabilities can be foreseen, but not their precise rate of change, the specific standards and designs that come into being, or the applications and reinventions that trigger market take-off and shape further development. Moreover, the recent dynamics referred to as 'open innovation' may also radically modify the way business is done in many contexts. In the near future, companies will start using participatory tools first within their own organizations, and then open them up to their customers on the web. This will make crowdsourcing effects an established phenomenon in management practice. Firms will therefore incorporate open source principles into their business models, as an effective diversification strategy to gain and sustain competitive advantages, in the context of a globally interconnected society. Virtual platforms such as today's Facebook or Myspace will be widespread and interconnected, with data exchange via secure networks available through open applications and systems. The majority of firms in the future will make use of a 'loose' intellectual property regime to extend their operations outside the formal boundaries of the organization, and orchestrate knowledge work via informal globally-distributed communities of practice [EC, JRC-IPTS, 2009a].

Citizens' attitudes towards privacy

It is likely that the trend of increasing personal data collection, storage and retrieval by governments will continue. Governments are likely to extend the current use of electronic databases of extensive and detailed profiles of citizens to provide services, increasing the possibilities for monitoring and surveillance alongside service provision. Citizens may accept such developments as a fact of life, and the nature of privacy will be changed [EC, JRC-IPTS, 2009a]. However, citizens may also reject such tracking and tracing activities and demand more privacy-friendly solutions, for example in the area of identity management.

Collaborative technologies will create possibilities for citizens to counter-surveille (inverse surveillance or sous-veillance) authorities and events. Activities will be recorded from the participant perspective, typically by way of portable recording devices that stream live video to the Internet [Hildebrandt, 2009, Kerr, Mann, 2006]. It is also uncertain to what degree people will embrace user-centred identity management devices and tools. These will be more widespread and user-friendly than today but still involve a cost in terms of commitment by citizens, who will live increasingly fast and busy lives. Identity will no longer be inherited but will be a constantly changing project for the individual, interwoven with reputation, credit, life-chances and social acceptance.

Economic growth

The path out of the financial crisis is uncertain. It is unclear whether global finance will enter a period of 'routine' instability with spells of high growth; or whether relatively stable growth will be resumed (and at what level, and when). Turbulence and even long-term depression may continue, triggered, for instance, by Enron-type scandals, or the accounts situation in Greece. The EU, still in the midst of the deepest recession since the 1930s, is working to ensure that recovery takes hold and to maintain the region's growth potential in the long term. The focus may increasingly shift from short-term demand management to supply-side structural measures. Failure could hinder the restructuring process and/or create harmful distortions in the Internal Market. Moreover, though the bold fiscal stimulus is clearly necessary, it comes at a cost. The projected rise of public debt in the euro area is 100% of GDP by 2014 [EC, 2009a].

10 See the Innovation Union Strategy, http://ec.europa.eu/research/innovation-union/

Despite the pressure of respecting the Stability and Growth Pact obligations, consolidation may be foreseen once recovery takes hold and the risk of an economic relapse has diminished sufficiently. Member States may take differentiated approaches, according to pace of their recovery, fiscal positions and debt levels, projected costs of ageing, external imbalances and risks in the financial sector. Preparing exit strategies, not only for fiscal stimulus, but also for government support for the financial sector and hard-hit industries, could enhance the effectiveness of these measures in the short term, as this depends upon clarity regarding the pace with which such measures would be withdrawn [EU, 2010]. The exact timing of these strategies will depend on the strength of recovery, on the exposure of Member States to the crisis and on prevailing internal and external imbalances.

Sustainability

One unclear trend concerns how public and political awareness regarding global warming and the depletion of fossil energy resources will actually influence western governments' actions. While it is expected that media attention to the climate change debate and to global warming, as well as recent natural disasters and energy crises have raised the perception of citizens on environmental threats and challenges to the survival of humanity, it is uncertain whether sustainability will become a key organising principle and radically transform private and public service delivery [EC, JRC-IPTS, 2009b]. Possible, alternative solutions include managing demand, providing more energy-efficient solutions and fast-tracking renewable energy and carbon capture. In this regard, there is a clear link between the exit strategy the EU will implement to recover from the financial and economic crisis and sustainability. Specifically, the exit strategy should preserve Europe's place at the frontier of the low-carbon revolution by investing in renewable energies, low carbon technologies and 'green' infrastructure, in a coordinated manner so as to avoid fragmented interventions and maximise impact. Citizen and NGO initiatives will increase and become catalysts for cultural change, so that a generational shift may occur in ways of living which support a sustainable global economy.

2.2 Policy trends

In this section, we present an overview of the main government trends and normative policy visions within and across European Union Member States that are emerging with respect to ICT for governance and policy making in the context of an evolving public sector.[11] The section is useful to understand the policy context in which specific trends in ICT tools for governance and policy modelling take place and to detect divergences and synergies between ICT trends and current developments within the public sector.[12]

The challenges governments are facing seem to fundamentally affect the scope of public sector activities. Society's expectations of public service delivery have not diminished since the 1980s, as citizens have become more concerned with choice and service quality. The paradox faced is one of open-ended demand versus a capped or falling resource share for actual delivery [OECD, 2005]. Consequently, public administrations are under constant pressure to modernise their practices to meet new societal demands with reduced budgets.

11 This policy review is drawn from the analysis conducted by IPTS as part of the Study on Social Computing and its implications for future public services, [European Commission, JRC-IPTS, 2008d] and the JRC-IPTS Scientific and Technical report on 'Public Services 2.0: The Impact of Social Computing on Public Services', (2009) [EC, JRC-IPTS, 2009c].

12 Details of the Policy Review are presented in the Annex B to the Deliverable D.2.2 of the CROSSROAD Project – Visionary Scenarios Design (available at www.crossroad-eu.net).

The key policy trends identified are the following.

1. Greater transparency and accountability of the public sector: a demand for a more transparent and accountable government can be discerned. Many EU Member States have put transparency and accountability policies in place.

2. Improved accessibility of public services: an increased awareness and perception of the needs and wishes of citizens, has resulted in a drive towards more choice and accessibility of public services. Both transparency and accessibility are linked to the call for increased accessibility of Public Sector Information (PSI).[14]

3. Quality, efficiency and effectiveness of the public sector: Many policies aim to deliver cheaper solutions while ensuring quality. Increased attention is being given to efficiency, as in many sectors government institutions face considerable budget cuts. This trend is mainly driven by dwindling public finances.

4. New models of governance and the emergence and active participation of new stakeholders: a trend that can be discerned in most public sector domains is the emergence of new partnerships, the involvement of intermediaries and the acknowledgement of new stakeholder roles. Citizens, civil society, and advocacy groups are increasingly empowered to organise themselves and play a role in public service delivery.

5. Stronger evidence-based policy: a resurgence of governance models that value principles such as accountability, monitoring and evaluation reaffirms the principles of evidence-based policy as a necessity for making informed decisions.

6. Citizen empowerment, expressions of diversity, choice: the role of users is being re-valued in a way that acknowledges their new-found skills and growing empowerment. The principles of facilitating increased participation, user-created content, user engagement, increased independence and ownership of public services applies to all public sector domains.

7. Improved digital competencies, bridging the digital divide: as they do in all domains, technologies are increasingly playing an important role in the provision of public services. Questions are arising in all sectors as what ICT skills citizens will require in order to have access to these services.

8. Promotion of independent living and self-organisation: policy makers acknowledge that ICTs can play an important role for inclusion of all citizens and in achieving social equity and cohesion. In many countries, ICT policies aim to enhance the independence of citizens – for instance, the elderly or disadvantaged people.

In summary, the influences and drivers of innovation and renewal in the public sector, combined with increased financial pressure on states not only result in change, but affect the pace at which the state adapts to the new environment, to its new roles and to increased engagement with stakeholders and 'customers'.

The policy review showed that drivers and prospective change span a continuum from offline to online and overall, the picture emerging from the analysis of policy trends in the governance and policy modelling domain in Europe can be summarized in the following box as three key areas of expected change.

13 See the Public Sector Information Initiative, http://ec.europa.eu/information_society/policy/psi/index_en.htm

1. The changing view and increased awareness of the needs and wishes of service users - citizens, businesses, administrations - introduces more choice, addresses user involvement and new processes of engaging with users, and also sees users in a new light. Users' new skills, and their skills needs, and their growing empowerment are acknowledged. The principles of facilitating increased participation, user-created content and user engagement and ownership of public services applies to the overall governance domain and related policy-making mechanisms.

2. New governance models introduce principles of efficiency, effectiveness, quality assurance and evaluation, leading to evidence-based policy as a necessity for making informed decisions. Also included in this trend is the impact of dwindling public finances and new ways are being sought to ensure value for money and quality in the delivery of services and efficient and effective organisation of the public administration to provide cheaper solutions and organise itself in a way that is more effective, interoperable and allows economies of scale. Strictly related to this overall trend is the fact that new partnerships are emerging, through the involvement of intermediaries and allowing new stakeholder roles. ICTs and especially collaborative technologies that facilitate user-generated content, co-design and co-delivery of services are therefore key drivers in this respect.

3. Digitisation of services, processes and interactions is expected to continue and become pervasive (thus leading to disruptive effects on lifestyles, governance and policy making). Policies and trends in the ICT domains show a consistent agenda and policy direction. Many of the core principles apply right across the various public sector domains in terms of redesigning governance processes and policy-making mechanisms.

These areas of change pave the way for increased openness of the public sector, for greater participation and user involvement, for new roles and 'e-mancipation' [Frissen, 2005]. They also stress the need for more integrated and intelligent policy-making mechanisms.

2.3 Research trends

This section is based on meta-analysis of state-of-the-art research, and aims to identify key research trends in ICT for governance and policy modelling in the future. The emerging research trends, the overall impact dimensions of research, and the expected resulting societal behaviours were examined in each of the five Research Themes identified by CROSSROAD [CROSSROAD, 2010a]. The emerging trends and impact dimensions have been further completed with selected normative visions proposed by experts' position papers to the CROSSROAD's Call for Contributions. Expected societal behaviour has been also considered in relation to the forthcoming trends resulting from the initial overview of the current FP7–funded projects.

This analysis allowed us to define a list of impact dimensions which characterize the broad research domain under investigation and to identify common trends, clustering them into broad cross-cutting categories across different research areas, defined as key impact dimensions (Table 2.3).

The key impact dimensions identified represent an aggregation of detailed impact dimensions which emerged from the analysis of the state-of–the-art. They are grouped into two main categories according to the contribution that the main elements of each research area are expected to provide in terms of opening up governance processes, while ensuring transparency; or in terms of integration of policy intelligence mechanisms and systems enabling a better data and knowledge management.

The reason for choosing these two broad categorizations is that the main assumption on which the overall domain of ICT for governance and policy modelling research is based is that novel ICT solutions could enable better governance and evidence-based policy making, through integrating and exploiting data and knowledge management

Table 2-3: Clustering of key impact dimensions

Aggregated detailed impact dimensions	Key Impact dimensions
Public sector information reuse	**Openness and transparency**
User-orientation	
Shift towards a 'Web-of-Data'	
Real time interconnectedness	
PSI aggregation/visualization	
New channels of service delivery / policy-design	
User-friendly / customisable collaboration tools	
User-created content and open source	
Availability of data on users' preferences / user-generated content and adequate representation of policy-related dimensions	
Intelligent information management tools in support of policy making	**Integrated policy intelligence systems for better data and knowledge management**
Policy simulation / options selection techniques	
Complex systems management	
Citizen-centric service delivery models	
Societal analysis on virtual world experiments	
Argument visualisation and simulation/visualisation of policy impacts	
User-centric, federated identity management	
New generation digital identity mechanisms	
New privacy enhancing technologies	
Privacy policies and regulations for digital living	
Digital rights protection and legal informatics	
Virtualization, service-oriented architectures	
Dynamic service level requirements	
Cloud Interoperability	
Virtual personalities	
Ambient intelligence	
Ubiquitous computing	
Multiple service provision channels	
Augmented reality and augmented cognition	

capacities. This however also requires further advances in other complementary research areas, such as defining appropriate legal regulatory frameworks and mechanisms, as well as more fundamental shifts in the organizational and societal structures which underpin the movement towards more open, transparent and integrated policy-making systems.

Finally, current FP7-funded projects have also been analysed with a view to linking forthcoming research trends addressed by the projects to the research trends identified in the analysis of the state-of-the-art and the experts' normative visions.

The forthcoming trends identified in the preliminary stage of research in each of the FP7-funded projects are shown in Table 2-4.

The combination of all the elements that emerged in the trends analysis helped us to shape the axes of the scenario design framework. The scenarios are thus able to develop in depth the trends in ICT for governance and policy modelling examined in this chapter.

Table 2-4: FP7 project overviews and forthcoming trends addressed

Project Abstract	Forthcoming Trends addressed
COCKPIT http://www.cockpit-project.eu/ aims to define a new Governance model which actively engages and empowers citizens in the public service delivery decision making process. Cockpit will combine the research areas of citizens' opinion mining in the context of Web 2.0, enhance Service Science Management Engineering in the context of the public sector and encourage deliberative engagement of citizens for forming informed judgements on public services delivery.	Globalization, increasing automation, and the growth of Internet are change-driving forces, which will inevitably stimulate Governments to reconsider the way they deliver public services. Governments are striving to deliver more efficient and effective public services in order to achieve better public service quality, with reduced waiting times, improved cost effectiveness, higher productivity and more transparency. It is an issue of doing things in new ways which requires fundamental change in the provision of public services in the future. Governments will take a completely new approach to working and interacting with their citizens. Ethical issues regarding data protection and privacy arising from the automatic extraction of citizens' needs for public services delivery from Web 2.0 mass collaboration applications will be investigated. Public service delivery cost estimation and citizen-friendly simulation and visualisation of public services' operation will be optimised. There will be a web-based, two-way dialogue (deliberation) between citizens and public service delivery decision makers which will help citizens to understand how public services operate.
I**MPACT http://www.policy-impact.eu/** will conduct original research to develop and integrate formal, computational models of policy and arguments about policy, to facilitate deliberations about policy at a conceptual, language-independent level. These models will be used to develop and evaluate innovative prototype tools for supporting open, inclusive and transparent deliberations about public policy. To support the analysis of policy proposals in an inclusive way which respects the interests of all stakeholders, research on tools for reconstructing arguments from data resources distributed throughout the Internet will be conducted.	Prior research on using argumentation schemes to generate focused surveys, minimizing noise and the need for manual moderation, will be extended in this project to support argumentation schemes needed for policy deliberations and generate surveys in multiple languages. Research will also be conducted on how to visualize arguments about policy, building on previous research by the participants, and extending this to visualize relationships between arguments and policies, in multiple languages. An abstract Application Programmers Interface (API) for the services required by the toolbox for content management systems will be defined, using existing standards whenever feasible. It will be validated by integrating the toolbox with an Open Source content management system which has been successfully developed or used in European eParticipation and other 'Web 2.0' or 'Social Web' projects. The tools in the argumentation toolbox will be designed and implemented as advanced Rich Internet Applications (RIAs) or widgets to increase usability, help overcome the digital divide, and facilitate consultations across languages and cultures.
OCOPOMO http://www.ocopomo.eu/ focuses on long-term strategic planning for governments and policy operators. Its objective is to implement an ICT solution for the target users to provide a collaborative environment for an integrated process of policy modelling to produce formal scenarios by means of simulation experiments and scenario-based futures development. This way, OCOPOMO enables actors of respective target groups at different levels of governments across Europe ,to master and shape future developments so that social and economic demands are met'.	This core objective of the project is to demonstrate that, with appropriate ICT, the integration of formal policy modelling, scenario generation and open and widespread collaboration is not only possible but essential at all levels of policy formation whether local, regional, national or global. The project will create an ICT-based environment which integrates lessons and practical techniques from complexity science, agent-based social simulation, foresight scenario analysis and stakeholder participation in order to formulate and monitor social policies to be adopted at several levels of government. Policy issues which are high on the European political agenda will serve as a testbed for the applied approach to policy modelling.

Project Abstract	Forthcoming Trends addressed
PADGETS http://www.padgets.eu/ aims to bring together two well-established domains, the mash-up architectural approach of Web 2.0 for creating web applications (gadgets) and societal modelling and simulation methodologies, in analyzing complex system behaviour. The objective is to design, develop and deploy a prototype toolset that will allow policy makers to create web applications that will be deployed in the environment of underlying knowledge in Web 2.0 media. For this reason, the project introduces the concept of Policy Gadget (PADGET) – similar to the gadget applications approach in Web 2.0 – to represent a micro web application that combines a policy message with underlying group knowledge in social media (in the form of content and user activities) and interacts with end users in popular locations (such as social networks, blogs, forums, news sites, etc) in order to get their input and convey it to policy makers.	The ever growing visibility of the web as a medium with the potential to attract and maintain society's involvement, coupled with the need for a citizen-centric and socially-rooted policy making, calls for novel tools with the capability to analyze society's input and forecast the possible impact of policies. Thus, new open governance models are evolving and are being implemented on top of social networking and cloud infrastructures. Through the PADGETS platform, any policy can become a reusable and communicable web application to be used in relation to underlying content and social activities over the web. Policy makers will be able to set up such applications on their own and use them to communicate their policies to the public. People can use these applications as they use everyday services and policy makers can track the results of this interaction back to their policy making process to assist them in reaching solid decisions that represent society's input and aspirations. Privacy and security mechanisms which are simple to operate will be incorporated into policy gadgets, so that policy makers and citizens understand what is happening and learn to trust data and knowledge sharing applications included in PADGETS.
The main argument proposed in the **+SPACES project http://www.positivespaces.eu/** is that virtual worlds are popular, diverse, established; they show spontaneous economic, political, and social parallels to the real world and aspects of socialisation and personality. They can be seen as a simulation of society, a microcosm. Through the +Spaces interface, government bodies will have at their disposal a set of operations they can perform in virtual worlds in order to test the impact of prospective legislation.	The operations made available by the project will vary from creating a simple poll to setting up a private space within the virtual world for simulating the legislation within a controlled environment.
UBIPOL http://www.ubipol.eu/ aims to develop a ubiquitous platform that allows citizens be involved in policy making processes (PMPs) regardless of their current locations and time. It is suggested that the more citizens find connections between their as-usual life activities and relevant policies, the more they become pro-active or motivated to be involved in PMPs. For this reason, UbiPOL provides a security and identity management facility to ensure that only authorised citizens have access to relevant policies, according to their roles in policy-making processes.	UbiPOL aims to provide context-aware knowledge provision on policy making. Citizens using UbiPOL will be able to identify any relevant policy and other citizen's opinion whenever they want, wherever they are, according to their usual life patterns. The platform will provide policy tracking functionality via a workflow engine and opinion tag concept to improve the transparency of policy making processes. In doing so, the platform will enable policy makers to collect citizen opinions more efficiently as these are collected as soon as they are created by citizens in the middle of their usual everyday activities.
WEGOV http://www.wegov-project.eu/ argues that social networking technology provides major new opportunities for policy makers (eGovernment) to engage with the community (eSociety). WEGOV will develop a toolset that allows full advantage to be taken of a wide range of existing and well-established social networking sites (Facebook, Twitter, Bebo, WordPress etc.) to engage citizens in two-way dialogue as part of governance and policymaking processes. The project will make it possible to detect, track and mine opinions and discussions on policy-oriented topics. The tools will allow discussions to be seeded and stimulated through injection of policy discussion points into relevant communities in a secure and managed way.	The tools developed through the project will allow the origins, bias and evolution of opinions to be tracked to provide auditable records of provenance, guard against misuse, and ensure trust and privacy for all involved. A key feature of the project's approach is to allow policy makers to move away from the limitations inherent in the current practice of using bespoke and dedicated platforms (e.g. specific opinion-soliciting websites hosted by government) and instead make full use of the high levels of participation and rich discussions that already take place in existing social networking communities. In this way, WeGov will develop the tools and techniques for closing the loop between policy makers and the citizens.

3. Scenario Design

This section outlines the scenario design framework for analysis of current and future challenges related to ICT for governance and policy modelling. It takes today's world and constructs images of possible worlds tomorrow, highlighting ways in which key uncertainties could develop. The aim is to present clues and key impact dimensions, thus increasing the ability to foresee possible development paths for ICT applications for governance and policy modelling. Thus risks can be anticipated and better preparations can be made to take advantage of future opportunities.[14]

Instead of attempting to forecast several future ICT-enabled scenarios, we chose to define four internally consistent – but radical – views of what the future European Information Society might look like in 2030. These represent four distinctly different views of what the governance and policy making system of the European society could be and what could be the implications for citizens, business and public services.

The pace at which the elements of the visions unfold will, however, be influenced by the speed of change of the overall technological landscape and societal context. Considering the unprecedented growth and speed of ICT uptake in several research themes and the rapid emergence of technologies which enable applications for ICT for governance and policy modelling (e.g. social computing, mobile technologies, pervasive computing, etc.), we can argue that the world in 2030 will be radically different from the world we are living in today.

First, we present the scenario design framework and use it to illustrate the possible future state of the world based on this framework. The scenario framework proposed was chosen to stimulate further debate and reflection on possible, radical alternative scenarios and is, of course, one of various possible alternatives.

We then introduce the scenario 'storyboards', which illustrate possible real-life situations in the different scenarios. We conclude with an analysis of prospective opportunities and risks identified for each scenario.

3.1 Scenario design framework

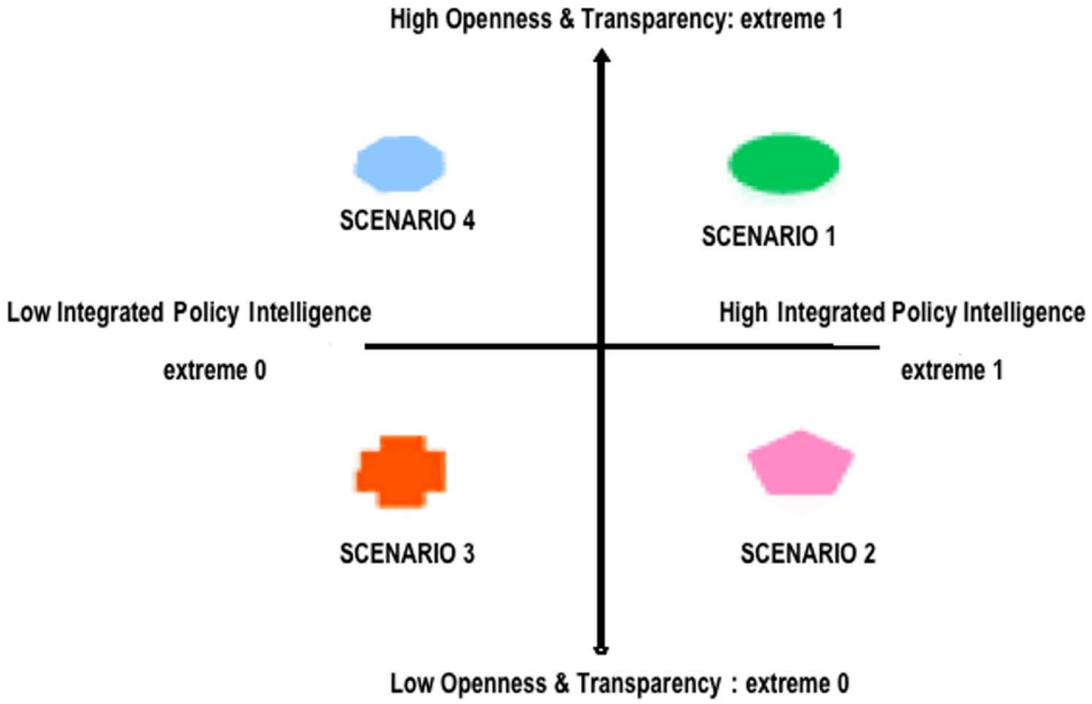
In Section 2.3, we presented the key impact dimensions likely to influence future research directions in ICT for governance and policy modelling. The impact dimensions identified have been further refined by analysing existing scenario exercises and the current shaping of policies and strategies for the development of the European Information Society.

Two basic uncertainties underlie today's key technology and societal trends related to future EU and Member States policies and research agendas: 1) the societal value system we will be living in: more inclusive, open and transparent or exclusive fractured and restrictive, and 2) the response, be it partial or complete, proactive or reactive, to the acquisition and integration of policy intelligence techniques in support of data processing, visualization and simulation for evidence-based policy making.

These uncertainties provide the two main axes of the scenario design (see Figure 3.1). The axes represent ways in which social and policy trends could develop.

14 In turn, this outlines key elements to be taken into consideration for the further roadmapping and impact assessment of future research in this domain.

Figure 3-1: Scenario design framework



The two axes are identified as: **Degree of Openness and Transparency (Axis Y) and Degree of Integration in Policy Intelligence (Axis X)** and they go from the extreme 0 (Low Openness and Transparency and Low Integration in Policy Intelligence to 1 (High Openness and Transparency and High Integration in Policy Intelligence).

The vertical axis indicates the degree of openness and transparency in a society, in terms of democratic and collaborative governance that could be further enabled by ICT. The most open and transparent society would be one where even traditional state functions are completely replaced by non-state actors, through opening-up and linking public sector information for re-use. Such a society would be, characterized by open standards and principles of transparency and accountability in governance and public management.

The openness paradigm is also expected to apply to the research and business community which could benefit from open innovation and social/business networks of collaboration, where users are co-creators of products and services delivered globally via peer-to-peer social networks based on reputation and trust. An important aspect will be the regulatory and technological solutions, but also the socio-cultural attitudes adopted concerning the basic digital rights underpinning the future Information Society. In fact, the concept of openness is not strictly related to technological solutions, but rather to socio-cultural and organisational aspects that can be enabled and supported by technological advancement.

The horizontal axis concerns Integration in Policy Intelligence, i.e. the degree of integration of data and knowledge and the modalities for enabling collaboration between all stakeholders in policy-design and decision-making mechanisms. This involves the possibility (enabled by ICT) to mash-up data and information available from different sources in an 'intelligent way' (meaning efficient, effective and able to generate public value). It also involves the extent to which users, individually or as members of formal and informal

social networks, can contribute to the co-design of policies, simulating and visualizing the effects of legal and policy decisions, and engage in real-time monitoring and prior assessment of possible expected impacts at local, regional, national and pan-European scale.

The horizontal axis is also associated with the capacity and willingness of policy actors to share power and change decision making mechanisms in order to facilitate the redefinition of basic democratic freedoms in a collaborative fashion. This could go to the extreme of redesigning the traditional mission of the State and the role played by governance stakeholders. Again, ICT are not the driving force; rather change is driven by changes in social values, attitudes and new paradigm shifts in terms of information management, knowledge sharing (experts vs. non expert networks, for example) and allocation of resources.

Scenarios are then developed in a narrative manner (i.e. storytelling style) as descriptions of possible outcomes in selected key areas, representative of the European context, where emerging trends related to the development of ICT tools for governance and policy modelling could have an impact.[15] The key areas are: 1) economy and society; 2) politics and governance; 3) industry and technology; 4) privacy and identity; 5) education and health; and 6) social cohesion and inclusion.

These areas have been chosen because ICT for governance and policy modelling research could make a contribution to them and have a considerable impact, by addressing core societal and governance aspects linked to policy making and public service delivery. Though other areas also could have been used to describe possible scenario development (e.g. energy and environment), the choice was limited to the above areas as these already affect the daily lives of citizens. Additionally, adopting ICT solutions for governance and policy modelling in the selected areas could radically alter the way users are involved.

In addition to the description of the scenario context developed, for each scenario a selection of specific 'scenario storyboards' are also presented in a structured manner. While a scenario describes an interaction example which illustrates the reference context that could develop in the future if a number of key dimensions and expected changes happen in a specific direction (i.e. a possible state of the future), storyboards (i.e. narrative representations of scenarios, like the ones used by film directors) may provide additional information to better describe possible real-life situations in which specific users (e.g. citizens, policy-makers, industry representatives, etc.) could find themselves. They provide a 'day-in-the-life' in the possible future contextual situations envisaged.

3.2 Scenarios for Digital Europe 2030

In Figure 3.2, the four scenarios were named according to their positions on the two axes of the scenario design framework:

1) **Open Governance:** characterised by High Openness and Transparency and High Integration in Policy Intelligence.

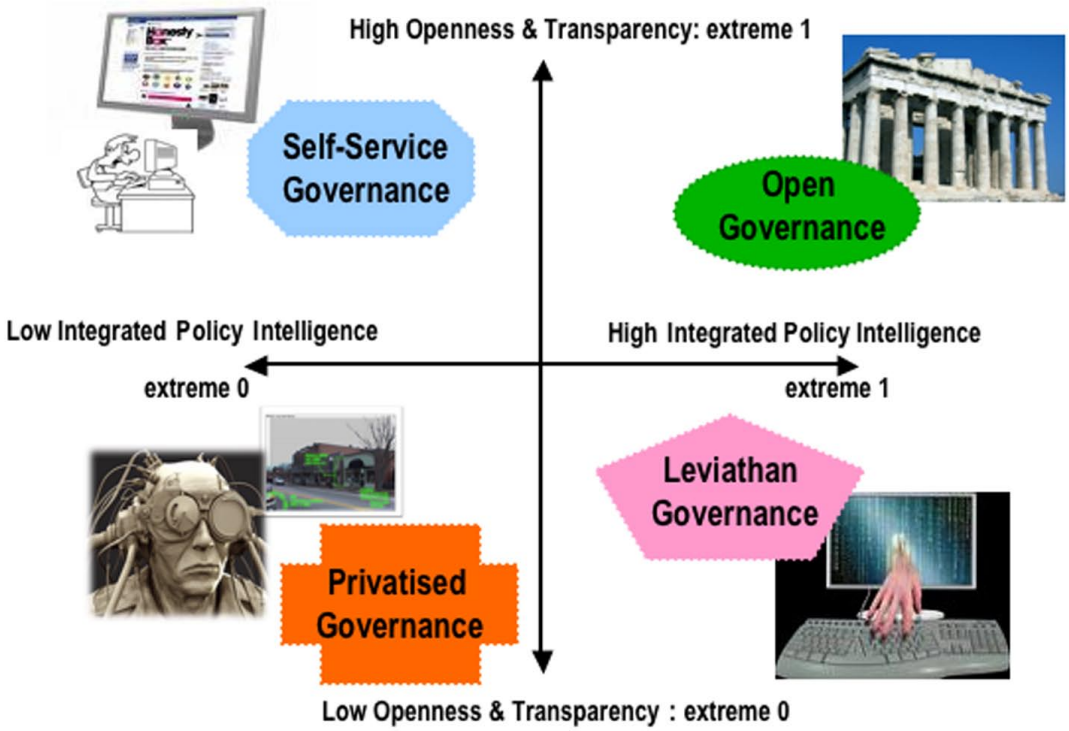
2) **Leviathan Governance:** characterised by Low Openness and Transparency and High Integration in Policy Intelligence.

3) **Privatised Governance:** characterised by Low Openness and Transparency and Low Integration in Policy Intelligence.

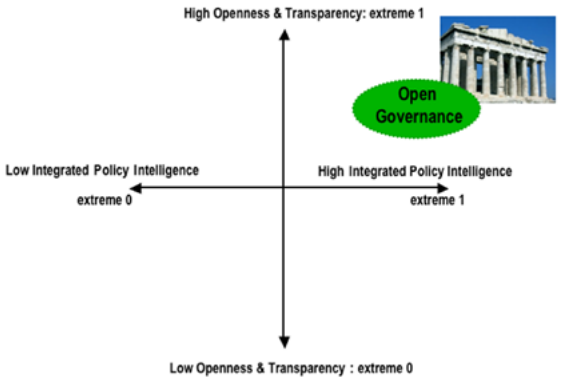
4) **Self-Service Governance:** characterised by High Openness and Transparency and Low Integration in Policy Intelligence.

15 General consolidated trends, such as demographic, environmental and social are given as stable as indicated in Section 2.

Figure 3-2: Scenarios for Digital Europe 2030



3.2.1 Scenario 1: Open Governance



Characteristics

High Openness and Transparency and High Integration in Policy Intelligence

Economy and Society

After several years of economic depression following the collapse of the financial system in 2008, in the period 2015-2020 Europe makes a remarkable recovery and experiences a period of economic prosperity and fast technological development, driven by user involvement. The ambitious goals set by citizens, in cooperation with government and industry, spurs innovative developments in all sectors of the economy and puts Europe in a front-runner position. The concern for sustainability has resulted in advanced systems that recommend and make available products and services based on ecological footprints. The depletion of fossil energy resources and the growing social awareness and mobilisation of citizens through user-enabling ICT applications has made sustainability the key organising principle for both private and public service delivery. The use of social computing applications has improved the transparency and accountability of the financial sector and ICT-enabled policy modelling mechanisms have facilitated data management and policy design and implementation.

In 2030, Europe will be an innovative and competitive knowledge society, building on the richness of its cultural diversity, overcoming

the multilingualism barrier, and exploiting the best of both tradition and creativity. Citizens will be generally optimistic about the future and will believe they can actively contribute to building the most equitable society in the world. Collaborative technologies and real-time policy intelligence instruments for monitoring and simulation of policy impacts will be used extensively in daily life, by businesses and in the public sector, for all kinds of purposes. As a result, citizens will be empowered, well-informed and eager to employ new and innovative initiatives in networked cooperation with the private and public sector, both as individuals and as part of third sector organisations and hybrid networks, both inside and outside the EU, establishing useful collaborations with emerging and neighbouring countries.

Politics and Governance

Citizens will be engaged in the decision-making process and make optimal use of the possibilities of ICT-enabled applications for governance and policy modelling to exert their influence on politics. A new participative model will emerge in which feedback loops and co-creation are fully integrated into the policy and decision making cycle of the EU and its Member States. User-enabling ICT applications and integrated mass-collaboration systems will enhance cooperation within government agencies and interaction with stakeholders, making processes more user-centric and cost-effective, bringing high public value to end-users. Public services will be performed by decentralised agencies in close cooperation with private actors and social movements, directly involving citizens. This will lead to the creation of a strong civil society that will coexist and support the representative model, giving birth to new types of partnerships and alliances between citizens, private companies and government. This will lead to networked governance systems where stakeholders cooperate via well established policy intelligence mechanisms and ICT applications, based on shared principles and values.

New modes of interest articulation and new processes of interest generation will emerge, with new ICT-enabled governance models arising especially at local level. This will also strengthen the EU governance system as a single body directly linked to citizens and their local and national representatives in real time. This system will be capable of integrating public opinions in policy-making and management of complex issues of importance at European and global level. Multilingualism will be addressed and harnessed, making it possible for all European citizens to communicate in real time on an ICT-enabled 'Esperanto platform', where immediate translation will be embedded into any ICT desk, portable application and distributed network system.

Industry and Technology

In 2030, the pace of innovation in Europe will be fast. The open environment in which universities, private companies, non-governmental organizations and users will work together will create an open approach to R&D in which users contribute actively. All actors will be 'linked in', creating instant feedback on new ideas, products and services. Ethical principles will be built into new technologies, products and services by means of value sensitive designs. Users will play important roles in the development of new services as co-creators and initiators. The convergence between nanotechnology, biotechnology, ICTs and cognitive science (NBIC convergence) and the development of ambient intelligence and ubiquitous computing will accelerate, thus influencing science, technology and society. New applications and reinventions will trigger market take-off and shape further development of collaborative technologies for governance and policy modelling, adapting to all needs of life and linking virtual and real world in a seamless space.

The successful migration from IPv4 to IPv6 will have already taken place in 2015 and an open and flexible high bandwidth ubiquitous network

will have been made available for free in Europe. This will allow the deployment of applications and innovative services, unimaginable years before. 'Always-on social networking' will be available on smart phones, portable devices and will be distributed in the architecture. The transition to a 'mobile society without mobiles' will have started; here, social networking and augmented reality applications will be part of everyday life and will improve personal autonomy and quality of life. Virtual offices will become the norm and media-streaming and broadcasting functionalities will expand the number of usages and users of mobile services, giving rise to a more efficient Internet of Services. Business and social life will be structured in a way that quality of life will increase in parallel with performance and productivity.

Privacy and Identity

Governments will open their databases to users, companies and third sector organisations; companies will increasingly make use of large and interconnected electronic systems with extensive and detailed profiles of citizens to provide better services and extend the possibilities for ubiquitous access and 'data portability'.

This will result in decentralised databases, distributed control and privacy enhancing technologies that provide users with powerful tools to control access to vital personal data used for personalised services. Citizens' perceptions of privacy will change as on-demand, privacy-friendly solutions demonstrate their value in preventing crime and controlling 'digital personae' in both the virtual and real world, with negligible risks and high convenience. Users will be involved in the active management of their personal data, opting in and out of services based on targeted and focused mining of their personal identity data.

Better public services can be provided via benign, positive discrimination based on advanced behavioural tracking and sentiment analysis, based on people' stated and contextual preferences. Companies will help governments determine people's preferences in all domains of life. Interoperability, federation and the portability of trust will allow 'government to government' entitlement management, seamless to the user and highly efficient as EU citizens travel across the Union. ICT-enabled applications for governance and policy modelling will allow citizens to monitor authorities and policy events, thus further increasing government transparency and quality of services. Automatic warnings and weak signals analysis will help determine the degree of privacy invasion for individuals.

Education and Health

In 2030, the European education system will be developed around the concept of 'Learning spaces', which are ICT-enabled, open, personalized and creative social spaces. Formal and informal systems of education and communities of practices will be connected to allow individuals to learn according to their preferences and interests, in a flexible way and without necessarily following structured and ageing curricula. Learners become co-producers of the learning process and play an active role while enjoying social networking and gaming with their peers and teachers, taking advantage of mixed-reality learning environments. While guidance and interaction will continue to be very important, the role of teachers, tutors and trainers will be shaped by ICT-enabled reputation-based mechanisms and rules, where reputation and feedback are more important than official roles and titles. Lifelong-learning will have a crucial role in education. It will be based on personal digital learning spaces where all learners can access a holistic and lifelong record of learning achievements and articulate their learning ambitions independently of time, location and access device. Technical skills and knowledge will spread across society, gender and age. In 2030, learning and education will be based on how people as inter-dependent and inter-connected social beings construct their identities

and produce the wealth and community that sustains their well-being.

In healthcare, by 2030 a new way of communicating and cooperating between patients and health professionals will be supported by large ICT-enabled collaboration systems (for homecare and addressing needs of senior citizens and disadvantaged categories). ICT-enabled platforms and policy modelling mechanisms, especially for simulation and visualisation of alternative policy options for health and care, will connect healthcare actors and stakeholders thus generating a critical, structured mass of knowledge, from both patients and researchers. This knowledge will be re-distributed for personal care and research.

These large ICT-supported collaborative networks will also foster advances in R&D to solve the tension between information property rights and open sharing which impeded until now the solution of diseases affecting large part of the world population. 'Open science' will become the rule and the majority of healthcare actors will have unrestricted access to gene information that will boost scientific discovery and ultimately lead to new therapies for most diseases. Advances in genome research and in the understanding of key biological processes will contribute to general health. Information will be exchanged in real time anywhere. Personal health systems, social computing, augmented reality and other ICT-enabled collaborative applications will make it possible to share knowledge and support patients with specific rare diseases worldwide, by simulating in real-time possible effects of drugs and by testing and simulating possible alternative care treatments. Moreover, the information gathered will be made available in different languages, thanks to ICT-enabled translation.

Self-care and automatic emergency interventions will be possible. The rate of child mortality and mortality as a result of viral diseases will be drastically reduced. Moreover, the new relationship between patients and doctors will foment new and efficient ways of organizing the healthcare sector, reducing costs and improving quality of services all over Europe. ICT-enabled healthcare systems will be critical for active ageing, by assisting the shift to a user-centric socio-healthcare system, sought for so long by experts and policy makers. Older people, who will represent a large proportion of the European population and healthcare system users, will benefit most from ICT applications and policy modelling systems that will enhance their quality of life, as life expectancy increases.

Social Cohesion and Inclusion

All groups in society will have web access and will have mastered enough ICT skills to make best use of ICT-enabled applications for governance and policy modelling. Senior citizens will participate actively in society and will be able to maintain and call upon extensive social networks. Migrants and ethnic minorities will be well integrated in society, also thanks to the widespread and effective adoption of user-enabling technologies. These will connect them to their home countries, supporting their development and reinforcing their cultural ties and 'cultural proximity' without isolating them from their host countries in separate virtual representations of their cultures. ICT-enabled applications will enhance social cohesion by improving personalised local service delivery and will increase people's freedom. They will create opportunities for local economic development, allow citizens greater participation in the governance process, and ensure that minority groups are represented in local institutional settings. ICT-enabled diaspora networks will facilitate greater integration and reduce cultural and digital divides in European host countries as well as in the home countries. This will also support a new development and cooperation approach by the EU that tackles global poverty and helps cooperation, especially with BRICs countries, in an inclusive global digital society.

Open Governance Storyboard: Climate change - open solution for energy efficiency

It is Friday afternoon in the typically very hot summer of Seville, and all households and offices are trying to keep cool. To minimise CO2 emissions and energy waste, the Mayor of Seville, Ms Souad Chaoui, has implemented, in collaboration with local industry and citizens organisations, a cost-effective, smart-grid intelligent network of all public and private buildings, set up by the local Universities together with international partner members of an Open Network for Smart Ambient Intelligence. This is complemented by an environmental modelling system accessible to anybody, and developed by the Seville-based IPTS, part of the European Commission's Joint Research Centre.

Over the last twenty years, Europe has been at the forefront of a new green-energy revolution, which has fundamentally transformed the ubiquitous but largely invisible infrastructure that powers every home appliance, every medical device, and every light source. Mobilising not just large utility companies, but also a whole ecosystem of small-scale generators and household producers allowed a decentralised system of energy production, consumption and distribution to develop on a platform of open and collaborative knowledge and capability exchange.

Social computing-enabled technologies and communities of practice have proved to be the key to managing the transition to a low-carbon economy. Internet-based platforms for innovation unified networks of willing and committed individuals and interest groups, generating new ideas, relationships and partnerships and providing new ways to analyse and understand how collective actions could translate into new energy solutions and concrete reductions in greenhouse gases.

In the past, city mayors centrally managed taxes and environmental credits imposed by Central governments after long and exhausting, not always very fruitful, global conferences and international protocols. In the new context, however, the City Mayor makes available ICT-enabled open platforms and distributed business laboratories where social entrepreneurs can launch experiments, build communities and attract funding for their ventures. They can also promote social networks where peers can challenge each other to take actions that effectively reduce emissions and measure their collective progress over time.

This is based on the availability of ICT tools which can turn raw data into reliable and usable information in real time. These tools make it possible for everyone - from investors to regulators to policy makers and ordinary citizens - to monitor actively the progress of local communities, nation states and corporations towards carbon neutrality.

Users themselves - be they large or small industries employees, government officials in charge of public utilities networks, or ordinary citizens, or groups of them organised in communities - use the new wearable wireless devices connected to the sensor network pervading the city of Seville. Thus they are able to access anywhere, anytime the web-based Open Network for Smart Ambient Intelligence, an intelligent and self-programmable network, which permits energy saving and redistribution, guaranteeing optimal production, consumption and delivery of energy in real time and according to needs of each user.

The system can run personalised analyses, make projections, and take into consideration user needs and wishes so that each user can take immediate decisions or even be alerted of anticipated changes of other users' behavioural patterns. The system also allows utilities to monitor and control their networks more efficiently, propose new and personalised business models and dynamic pricing schedules for different purposes and user behaviours. In addition to this, users, armed with detailed information, updated in real time, about needs, tariffs and consumption levels, relying on an open and transparent smart energy grid, can programme their electric appliances (such as dishwashers or air conditioners) to wait for the price to fall below a certain level before automatically turning on, and turning down when the price goes up. In this way, the system not only reduces the cost to each user, but also accommodates consumer preferences for clean sources of energy. It even allows households to select their desired supply mix, based on geographical location and 'nearest point of distribution'. More importantly, however, it minimizes greenhouse emissions. Thus, after many years of discussion and protocols, climate change has been detained and the future of Europe and the world is green and bright. It is now based on a new ethos of openness that ensures that the smart energy grid platform is not only a computerised pipeline for delivering cleaner electricity, but also a global innovation platform on which a vast array of new energy services and innovative ways for producing, consuming and delivering low-carbon solutions can develop. These change people's lifestyles and increase their quality of life.

It is Friday evening, time for tapas with some friends. The City Mayor of Seville checks her wearable wireless device connected to the web-based network, and is satisfied with the level of energy consumption. This year, Seville even managed to save energy credits. These have been transferred to neighbouring countries, particularly to Morocco. At the week end, she can rest on the beach in the Doñana National Park, still a natural oasis in 2030, before going to Tangier on Monday, for the inauguration of a similar Smart Ambient Intelligent network covering all of North Africa, developed in cooperation between the EU and the neighbouring countries.

The world is green again and the City Mayor of Seville is happy that her community is contributing to solve this global challenge.

3.2.2 Scenario 2: Leviathan Governance

Characteristics

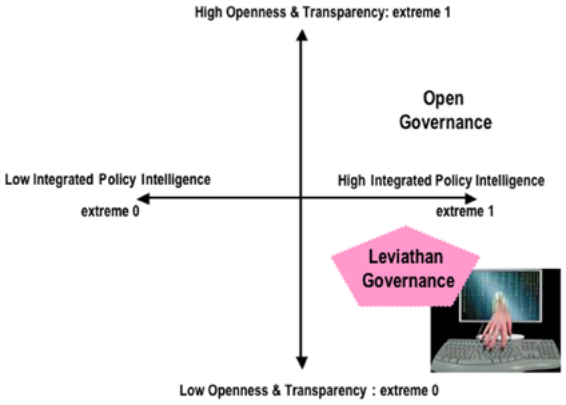
Low Openness and Transparency and High Integration in Policy Intelligence

Economy and Society

The deepening of the financial crisis after 2010, and the economic depression caused by failures in soft recovery interventions initiated in the EU to regain prosperity, prompted Member States to intervene directly to nationalize financial institutions and limit de facto the EU single market, thus taking Europe back to a pre-Euro era. In an attempt to promote economic growth and development, national governments established strict regulatory mechanisms of control and surveillance of financial, credit and private sector operators and individuals, by centralizing databases and improving cooperation for monitoring cross-border exchanges and movement of capital, goods and people. The basic freedoms that underpinned the European acquis and society until 2010 were withdrawn by national governments in the interest of guaranteeing national security. Citizens were persuaded that this was the only way to regain economic wealth. They believed that their governments, supported by technological advancements, would guarantee security and equal benefits for the majority by limiting their fundamental freedoms.

Politics and Governance

By 2030, traditional deliberative democratic systems will no longer be required and European society will be characterized by the presence of passive citizens who, under the guidance of a limited oligarchy of benevolent leaders, will seek to implement the policies decided by an elite of bureaucrats trained in top national public administration schools, aided by special national secret police forces. Relations and policies within the EU will be discussed in secret fora and international relations with non-EU countries will be reduced



to non-proliferation treaties in order to ensure a peaceful order within the community. EU borders will be secured by advanced ICT-enabled fences that prevent intrusions from foreigners. Freedom of circulation for EU citizens outside the EU will be limited and monitored, when allowed. These control systems will be implemented by means of robots and automatic processing, based on wireless sensor networks and virtual geo-ICT solutions.

Advanced real-time systems will gather data on the opinions, attitudes and activities of citizens, who provide their input to policy via automatic policy design mechanisms and rule-sets. These systems will lead to data aggregation in a single intelligent repository of information on the society's behaviours and preferences. Decisions on what is good for the community and individual citizens will be taken by automatic processing of data via ICT-supported decision systems which will allocate resources, benefits and obligations based on an 'objective function'.[16] This will also permit the deployment of targets services and personalisation of care. Despite being formally allowed, freedom of expression will not be exercised by citizens as they will see it as redundant to the decision system, which will be steered by androids supporting the benevolent leaders and the elites of bureaucrats. Decisions will be taken without transparency and no opportunities for open comment on what has been decided will

16 A function associated with an *optimization problem* which determines how good a solution is. (See: *Algorithms and Theory of Computation Handbook, page 34-17 (1999) by CRC Press LLC. Appearing in the Dictionary of Computer Science, Engineering and Technology, (2000) CRC Press LLC).*

be offered. Political engagement will be strictly regulated. Governance and decision-making will be reduced to automatic data processing. Policy intelligence tools will support the modelling and execution of the best policy options available for the majority, with significant improvement in efficiency and effectiveness of resource planning and allocation, significant reduction of systemic corruption and possibly improved planning and collective benefits for the society.

Industry and Technology

All key industries in 2030 will be owned or controlled by the state. Public enterprises will guarantee the production and delivery of key products and services of public interest. Private sector companies will be at least 51%-owned by public entities and will be allowed to provide additional services, but only as sub-contractors to nationalized companies under strict profit-sharing rules.

The transition of the Internet IPv4 to IPv6 was successful, but due to the need to safeguard free access to Internet, the addressing-routing space was declared a 'national critical resource' in early 2020 at the last meeting of the Internet Governance Forum, under the auspices of the International Telecommunication Union (ITU) (before it was dismantled). Since then, Country Internet Registries (CIRs) have been established, replacing the old Regional Internet Registries and they are the only institutions allowed to generate and authorize Internet traffic at national level. The relations among CIRs are controlled by a body that regulates principles and worldwide allocation of IP addresses. This also implies control on routing, and deep packet inspection.

All privately-owned objects will have in-built Real Time Location systems (RTLS).[17] which will improve the monitoring of citizens' movements and digital activities, to guarantee their security and provide real time services. This will make it easy to prevent the circulation of opinions that may not be in line with government policies, thus inhibiting possible dissent or alternative voices.

Privacy and Identity

Citizens will accept giving up their privacy in exchange for better services. They will also avoid the security issues associated with the increasing digital transactions via integrated systems and ubiquitous networks where objects, services and people are always connected and communicating feelings, opinions, tastes and preferences. The distinction between personal identity data, public data and commercial intelligence has faded, as all information about people may be collected and analysed for the collective good. To avoid the constant need of taking decisions autonomously, identity management is determined automatically, in real time, through Digital Reputation Analysis mechanisms performed by a National Digital Identity Management Intelligent System. The system is able to gather, process and visualize citizens' 'digital shadows' (and also update in real-time all social networks profiles and relations among users). Consent is not required to process personal identity data, as intelligent systems determine the degree of disclosure required for a specific operation. Decisions are taken automatically by the system and a Digital Identity Brigade, composed of androids, robot and software agents, safeguards the correct allocation and functioning of the system, to avoid, for instance, too many friends in social networks or followers in micro-blogging. This could cause excessive popularity of individual citizens and this could be considered dangerous for the safety of the citizens and the society. Some citizens, who do not trust the system, will be allowed to opt out. They will, however, be excluded from important social services, such as health, education and security.

17 Extending to humans the Cowdetect system, used in 2010 to monitor how cows move or sleep, so as to know whether they have any health issues or if they are ready for insemination.

Education and Health

In 2030, education and health services will be provided by national public institutions certified by the Digital Reputation Management system. The availability analysis, processing and visualization of locally-relevant digital data, and the integration of participatory sensing with the monitoring of subjective opinions will automatically trigger collection of the perceptions of learning or health needs and determine service delivery. This will improve individuals' learning behaviour and develop tailor-made advanced training packages with no need to attend classes. No time and resources will be wasted for schooling and training, as all will be part of the labour force from the age of 15, thus increasing productivity and national growth. However, learning patterns will be closely monitored to avoid discrepancies with predefined programmes; creativity-based courses will not be allowed, in order to prevent innovative thinking, which could lead to questioning the social order and common welfare.

In health care, real-time data will be constantly gathered to monitor patients' status (e.g. measurement of health parameters) and send them information (e.g. reminders and advice on suitable therapy). Also, participatory sensing systems will collect data from individuals, thus monitoring the diffusion of potential pandemics, providing earlier alerts about imminent outbreaks and thus reducing risks of transmittable diseases. In case of emergency, to avoiding the spreading of diseases, automated policy execution will isolate patients who cannot be saved, even by the advances in health care or by transplanting augmented reality extensions.

Social Cohesion and Inclusion

Integration and social cohesion will be guaranteed by default. Tracking and automatic redefinition of digital profiles and personalities in 2030 will be possible via the integration of online systems and augmented reality extensions to individuals' bodies and brains. A digital reputation management system will guarantee the desirable level of multicultural mix in the society by automatically allocating real and virtual profiles (including avatars in the case of ethnic minorities already eliminated) to the population. To prevent possible conflicts, the artificial policy intelligence systems connecting individuals with the national digital management reputation system will be reloaded in case of need, including when they are travelling abroad (physically or virtually) to explore other cultures, mainly from the old turbulent times of the early 2000s. Information about the past centuries (pre-2000) will have been deleted to save space on the digital memory system. In order to safeguard social peace, in fact, strong emotions such as joy, love or other passions will be controlled and peer-reviewed.

Leviathan Governance Storyboard: Natural disaster - earthquake affects west coast

It's Monday morning and Jack is driving home to prepare for his 2-month business assignment abroad. He talks via a video-call with his wife Jane, who has just returned home and informs him that the kids are also on their way as the Central Government Intelligent System has customized their personalized training programme at school to this event. Suddenly, the call is interrupted and everything around Jack starts shaking. Before he realises what is happening, it's all quiet again. He jumps out of the car and within a couple of seconds, before he starts to talk to other drivers who have also pulled over, their mobile phones simultaneously receive a crowd-sourcing message: 'An earthquake of magnitude 7 with a submarine, shallow seismic focus hit the country today at 16:03. Everything is under control. Please remain calm and, if necessary, further instructions will follow shortly.' This reassures them that the government is taking appropriate action as always. However, Jack is still worried about his family and tries to track them by accessing the Real-Time Location System (RTLS) on his mobile phone. Their current status indicates that they have not been injured at all. His wife is a little anxious, so their real-time doctor has advised her to take a sedative pill as a precaution. The kids will get home 15 minutes late as the route that the school bus normally follows has been recalculated because some old buildings have collapsed downtown. As soon as he arrives home, Jack receives a cancellation notice for his trip. He can now relax with his family, at least for the rest of the day!

At the time of the earthquake, Michael is cleaning his bike in his house near the west coast beach. He senses the ground moving but does not pay any particular attention as low magnitude earthquakes often happen in this region. Within a couple of seconds, though, he receives an urgent notification on his mobile phone: 'A tsunami, the result of an earthquake of magnitude 7 with submarine, shallow seismic focus that hit the country at 16:03, is anticipated to hit the west coast within 6 hours. Please take appropriate action'. Michael already knows he must evacuate his house within the next 2 hours at the latest and head towards the mainland. As he approaches his house to pack an emergency suitcase, the door opens at his vocal command and he notices that all electronic devices have been automatically deactivated (although the energy supply network is functioning normally), all windows and doors apart from the main entrance are already sealed and all objects have shifted to a 'self-protection' mode. On his way out with a full suitcase, his laptop which he accidentally forgot, emits an 'I feel so lonely...' signal. He instantly grabs his briefcase with the laptop and closes the door hoping that the tsunami will not affect his house, at least inside. As he drives towards the mainland, his bike screen notifies him that they are heading towards the 3rd temporary relocation centre and he still has 150km to go. He is visually connected to the centre and is reassured that everything is under control there.

Five minutes before the earthquake, early emergency warning systems within the Central Government Intelligent System (CGIS) inform about a large earthquake resulting in a tsunami that will hit the country. All the oligarchs, irrespective of their location, use any available device or thin, organic display adaptable to any surface (e.g. walls), with the ability to securely deliver high quality media content, such as images or video animation, and support a video-conference. While they are still waiting for the earthquake, the CGIS assures them that proactive measures have been already taken (sufficient numbers of doctors and fire fighters are on duty, warning messages to neighbouring territories have been sent, etc.) and presents in detail the earthquake repercussions. A few moments after the earthquake, the CGIS sends re-assuring personalized messages to all beings and critical devices, according to their location and status, based on information gathered and analyzed by the RTLS system. Then it notifies the oligarchs that 94 people are slightly injured and 5 empty, old buildings (deserted since the 2000s) have collapsed, as it reorganizes the energy and transportation networks. The oligarchs sigh with relief and, while waiting for the complete 3D simulation results for the tsunami with the help of visual analytics tools and virtual world experiments, they start to discuss the long term planning for recovery. Through an automated cognitive process of allocation of resources, the CGIS, already aware that approximately 468 families will have to be permanently relocated, controls these families' temporary relocation to 12 centres (i.e. hotels and new, empty apartments). Then, within the next 12 hours, it recalculates the 'objective function': who gets what, where and when (wealth redistribution, restructuring, financial planning, etc.) and presents a viable solution to the oligarchs who unanimously approve it and initiate all the necessary next actions.

'The most difficult emergency situation due to a high magnitude earthquake has been skilfully controlled in our country today…', 'In the end, we survived the tsunami with little damage …', 'It was about time for a change in our lives: new locations, new houses, new jobs, new lives. Let's see how it evolves…' are indicative examples of status updates in the social networks and the micro-blogs the same day.

3.2.3 Scenario 3: Privatised Governance

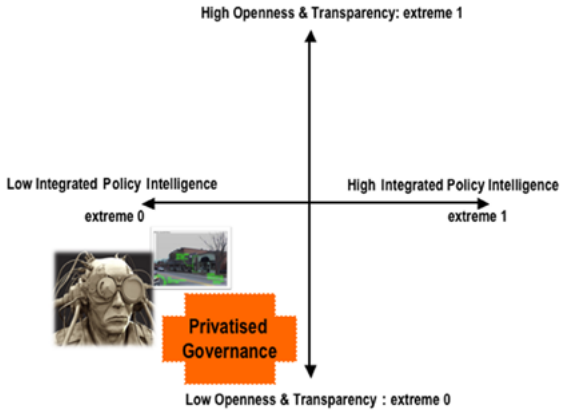
Characteristics

Low Openness and Transparency and Low Integration in Policy Intelligence

Economy and Society

In the aftermath of the economic depression of 2010, European governments focused exclusively on fixing the financial system by adjusting fiscal policy and subsidising large transnational credit structures. Most European Member States lost legitimacy due to the disappearance of the welfare state, paralysed during the crisis. In 2030 European society will be characterised by self-concerned attitude; a dual society will exist with growing gaps between fewer rich people (20% of the population) and more poor people (80% of the total population). Poor participation and governance will allow established actors to take power, thereby creating a clientelistic polity. Corporations will take advantage of the lack of regulatory frameworks, trust and engagement of citizens, and use ICT applications and ICT-enabled control systems to 'privatize' the Internet. Thus access to critical sources will become very expensive and a number of competing and conflicting networks will be created.

The idea of a European society will be lost, along with the wealth it enjoyed at the end of the 20th century. Hence, the EU system will be questioned, and nation-states and local governments will increasingly demand separation. This will lead to the fragmentation of society and the disaggregation of the EU into smaller, ad-hoc partnerships. The sense of the EU as a cultural and social entity will be obliterated by private and corporate economic interests which work at global level. Cultural and religious tensions, exacerbated by language differences, the incapacity to use collaborative applications and separate policy intelligence tools to mediate between diverse opinions and interests will mobilise social activists to carry out armed protests.



Politics and Governance

A return to the European Economic Community will take place, where economic interests prevail and only free market rules apply. Government loss of legitimacy and the growing role of large corporations in implementing intelligent autonomous policy mechanisms based on proprietary ICT-enabled systems will drive economic and technological development, leaving little room for citizen involvement except as employees and consumers. Between 2020 and 2025, politicians will give up trying to regain their citizens' support and will decide to focus on minimizing administrative responsibilities. Governmental institutions at EU-level will therefore disappear. Due to the lack of engagement of governments and citizens, the balance of power will be upset in favour of the private rather than the public sector and there will be few counterbalances to compensate. Between 2015 and 2020, the exponential growth of citizen initiatives using collaborative technologies and 'cyber attacks' to established political systems will cause an information overload, exacerbating conflicts and inequalities. This will lead private network operators to reduce Internet access and activate individual private networks and ICT-enabled solutions to communicate. Many people will not have access to social computing, which will only be used extensively by the few who do have access.

This will result in increased security threats from political activists feeling unable to exert influence, who will hack into large policy intelligence systems and ICT-based applications

and networks. This will create societal tensions which will be exacerbated by the media. By 2030, the media will produce and disseminate content using social computing and other ICT-enabled collaborative applications exclusively. It will not be possible to check information before publication, which will lead to widespread confusion, constant false alarms and incorrect information on individuals and organisations. This will result in extensive surveillance. Private security businesses will play an important role and will be able to trace and track individuals connected to any ICT-enabled system. Policy and decision making systems will rely on reports automatically generated by the security corporations' ICT-enabled systems and the governance process will be exclusively monitored by a 'Permanent Steering Committee' composed of the CIOs of these corporations.

Industry and Technology

In 2030, technological innovation and growth will be very high but it will rely exclusively on private universities and corporate labs. Together with private design firms and virtual professional organisations, they will be the source of profound scientific knowledge that will make rapid incremental innovation possible. Internet and ICT-enabled collaborative technologies will have evolved over time into discrete systems that collect data and link virtual and real world. This process will have further accelerated technological innovation; advances in ambient intelligence technologies will have increased the intelligence of the Internet and the possibility to anticipate citizens' needs in real-time. For example data will be delivered when needed, and control of signalling and payment systems will be improved. All data generated claims to improve quality of life, but in reality personal autonomy will be surrendered to technology and decisions will be made in an unreflective way, thus limiting in practice the capacity of human beings to manage technologies.

Moreover, conflicting views on what directions technological development should take will have prevented standardisation and systems integration. In this connection, the debate on the risks and opportunities of the shift from IPv4 to IPv6 will have been delayed the transition. When the migration finally took place in 2017, it was directed mainly by private sector players promoting their networks. Similarly, cloud computing shied away from an open public architecture to result in a plethora of smaller, inefficient separate corporate clouds. The market fragmentation and the privatisation of the Regional Internet and Cloud Registries ignited conflict to gain market shares. Internet addressing routing space, which will have become a scarce resource, will be allocated on payment of fees. The Internet will regress into a number of conflicting and competing networks, based on proprietary protocols. A small number of surviving companies will establish a cartel to increase prices, where even sending emails will be expensive. Self-organising ICT-enabled applications will drive human decisions. The capacity to influence user behaviour through social computing and other ICT-enabled collaborative networks will make industries compete over ownership and creation of new networks, which will be closed and specialized. These networks will be reminiscent of private LANs, as access will be controlled and they will provide private services.

Privacy and Identity

ICT-enabled platforms, embedded in increasingly privatized networks, will use databases with extensive and detailed citizen profiles to provide services, extending the possibilities for monitoring and surveillance. Financial profiling, which was one of the causes of the previous financial meltdown, was replaced by a credit system that takes citizens' behaviour, thoughts and preferences fully into account in order to assess their financial risk, regardless of social and political priority setting. People's personal identity data will be sold between corporations on a personal data information stock exchange, akin to the eyeball

market for television advertising in place before the year 2000. This will create a seemingly 'free market' for identity and for the services associated with it. Only very wealthy investors will be able to buy back their data from the market, if they so wish. As a result, a proportion of the population will be excluded from vital services based on credit (including advanced health care) as they do not have enough 'identity value'.

Citizens will try to reject such tracking, tracing and selling activities and demand more privacy-friendly solutions and control in identity management. However, the lack of regulatory frameworks and balanced power systems (with no possibility to participate in political decision making and governance processes) will preclude a change in the rules defined by corporations. This will lead to the creation of a black market of multiple and fake identities, in an attempt to escape surveillance and control of personal activity. This may lead to a number of secret organisations which will try to fight against pervasive commercial surveillance. It will also lead to a massive reduction in the use of web networks and the emergence of alternative systems for communication, information exchange and knowledge sharing, based on low-techs.

Education and Health

Education and health services will be privatized and offered by large corporations, using ICT-enabled intelligent systems to enable mass customization and virtualization. This will imply the implementation of monitoring systems to trace the all aspects of citizens' activities and personal information, including their education and healthcare details. For example, learning will be virtualised and optimised, allowing citizens who can afford it to plug into online learning modules, delivered by the private sector. Intelligent systems, connected to databases, will monitor learning performance and determine learners' educational paths by recommending new modules. However, most users will not be able to pay for this, nor will they trust private organisations, resulting in the creation of alternative, decentralised services as users take upon themselves responsibilities for education and healthcare.

Students of all ages will have their own education 'portfolios' and will be advised by peers and private professionals about suitable modules for their learning needs and educational level. Traditional text books will have been abolished; learning materials will be created online and in augmented reality spots by students and professionals. Although effective, these informal learning systems will not be recognised by authorities and employers. Students wishing to move into the workforce will be required by industry to have their skills certified through formal education. Lifelong learning will, however, be made possible by strong cooperation between citizens, former academics from public universities (most of who are now unemployed) and emerging start-up businesses, which will have identified a niche opportunity. Quality of education will be negatively affected with inherent consequences for the competitiveness of the specialised labour force which in Europe. Special skills will need to be imported from outside Europe.

In health care, patients will be able to perform a number of tasks themselves through self-monitoring and self-diagnosis and exchange of experience and knowledge with both patient and professional communities, resulting in collective self-provisioning. However, healthcare providers and insurance companies will use the information to personalise their services and increase premiums and rates, and the quality of the overall healthcare system will be reduced. This is also caused by the fact that the relationship between patients and doctors is limited to the exchange of opinions on social networks, where healthcare professionals will be challenged, thus loosing credibility and interest in providing feedback. ICT-enabled patient communities (mostly based on social networks) will take the lead on healthcare, but will often be driven by the interests of private companies. Moreover, false information about pandemics (such as swine 'flu) will spread over

social networks, giving rise to alarms and fears worldwide. These worries will be propagated by spammers and phishers, making increasing use of ICT-enabled applications and false policy modelling systems to exploit people's fears of rapidly-spreading diseases. This will ultimately affect social life as people will avoid public spaces due to the fear of contagious viruses, which are actually only virtual.

Social Cohesion and Inclusion

In 2030, most citizens will not be able to participate in the private social networks. Less powerful groups will thus be excluded, as power will be in the hands of business lobbying groups, which aim for low participation. Moreover, the interests of different groups will be increasingly conflicting, thus complicating the legitimacy of opinion shapers, such as the media and political groups, and making consensus impossible. This will fuel an explosive situation in society, polarizing different socio-political groups and enlarging inequalities and social exclusion. Immigrants and ethnic minorities, for example, will be heavily discriminated against and the European society in 2030 will be closed to any form of difference, and there will be extreme intolerance in both the virtual and the real world. Moreover, advances in genome research and the availability of personal citizen data will make possible to trace individuals' genetic and ethnic characteristics. This information will be used to limit the access minorities have and the services they receive. Thus, exclusion will be increased digitally, and new digital and societal divides will be created all over Europe.

Privatised Governance Storyboard: A new global pandemic - the spread of an unknown virus from Asia

At about 3am on Wednesday night John Parker, CEO of one of the larger worldwide private corporations, is woken by a horrible noise. He needs a second to recognise that the noise comes from his company's RAEWS (Risk Assessment Early Warning System). Immediately his adrenalin starts to flow and all his senses are alerted. While still bit disoriented, he asks RAEWS: 'Good morning darling, what's happening?'

Although RAEWS is just an ICT system with a human presence interface with the voice and look of a human being, he has a personal relationship with it. He consults 'her' frequently in his professional life and almost as often in his private life if incidents happen, because RAEWS helps him to minimise risk from flaws in human decision making. As a result, 'she' has become the most important 'person' in his life. John knows that he can always count on 'her'. RAEWS runs billions of simulations based on data gathered by sensors and collected from continuous monitoring and analysis of networks, businesses, customers, and the whole environment.

This includes information at the global level - country divisions have become irrelevant. RAEWS explains to him in natural language and shows him through visual analytics that all 'signs' indicate that a global pandemic, spread by an unknown virus, will hit his area on Monday, three weeks from now.

The global business that John Parker and the members of his management team carry out forces them to live nomadic lifestyles. 'So, what can we do to avoid this?' asks John and RAEWS provides him with a detailed strategy (RAEWS also has a decision making support function based on the 'co-opetition' approach, which involves collective thinking).

RAEWS tells John how his company can benefit from cooperating with other companies. After running several simulations, she identifies a strategy for containing the approaching pandemic by cooperating with several major health care corporations and other private actors, keeping costs to a minimum and even making a profit in some areas of his company's business. To protect his company and its subsidiaries, John agrees to health protection for his employees, as all companies do.

Health care is a rare good, which is reserved for employees only - unemployed people have none. Since no effective antidote can be developed in the short time available, RAEWS shows John that he must cooperate with suppliers, partners and customers in order to set up new ways to communicate and interact. Hence, ICT for collaborative work, video-conferencing and other virtual ways for real time communication are integrated into the existing teleworking infrastructure, thereby providing mixed realities. Additionally, robots are deployed to allow service infrastructure to keep working.

ICT systems like RAEWS are very important for governance and policy modelling in this context. But there is no centralisation or integration of different RAEWS into one overall system as companies compete with each other. Hence, each international corporation will use their own platforms which are only partly interoperable (there are high levels of diversity) in order to exchange necessary information if rapid collaboration is needed, as it is in this case.

In this pandemic scenario, corporations are the 'heroes' who rescue the society and economy as governments are not able to intervene. A pandemic could cause the collapse of the society in a 'domino effect', but the corporations do not want this. The wellbeing of citizens is important to them as they are both employees and customers. Competing companies are therefore prepared to cooperate to address problems like this one.

Although the existing fragmentation and the fragmented innovation could give the advantage to those corporations which are better prepared for a crisis, they need to mutually support themselves as there is no government strong enough to act,

In the future of privatised governance, policy making is replaced by business intelligence tools, because the administration is weak and not able to take decisions. Only those who were able to invest in innovation (e.g. to detect the means of counteracting a virus, or isolating it, in order to hinder its spread) can face up to a pandemic. However, they will not be willing to share their knowledge, unless it is necessary for the sustainability of their business.

In this context, international business will be the only reason for European cooperation, weak governments will not cooperate. There is no interest in small companies or citizens, unless they are a part of the value chain of a bigger company.

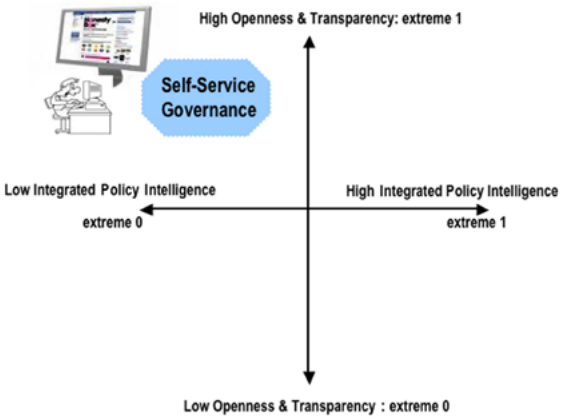
3.2.4 Scenario 4: Self-Service Governance

Characteristics

High Openness and Transparency and Low Integration in Policy Intelligence

Economy and Society

The financial crisis that Europe experienced in the period 2008-2010 will have deepened in the next decade and pervaded all economic sectors. National Governments and the EU will not have been able to solve the crisis and several economies, starting with Greece, Portugal, Spain, and Iceland followed by several other EU countries will have incurred heavy debts, mainly financed by emerging countries, such as China, Brazil, India and South Africa. This financial turmoil will also have lead, for the first time in history, to the incapacity of the financial market to function and hence to the abolition of most European stock exchange systems. The impossibility of initiating a new cycle of growth and development and the increasing pressure created by protests from citizens, exasperated by the high percentages of unemployment and the high prices for basic public services, will have lead to a massive failure of traditional economic systems. Public services will be provided mainly by private operators in the absence of any rule and supervision by the national states institutions despite the imposition of increasing taxation. European society in the decade 2020-2030 will be characterized by a high rate of poverty and crime. Due to the incapacity of the governments to react, citizens will organise themselves locally or in communities of interest, in order to manage public and private services. They will be supported in this by the exponential development of self-governing ICT-enabled systems, especially those based on social computing and mobile technologies and applications, connected to ambient intelligence environments created on an ad-hoc basis by individual users or user communities.



Politics and Governance

By 2030, the national state, as we now know it, will have failed and in most European countries institutional governments will have been dismissed and replaced by self-organised and self-governing communities of citizens, based on online reputational management systems. An online referendum will have taken place to evaluate the results of the largely unsuccessful EU Digital Agenda 2020. In theory, national powers will have been subjugated to a new supranational body created under the banner of the EU. In practice, however, decisions will be taken at level closest to citizens, taking the principle of subsidiarity to an extreme. Traditional elections will have been replaced by online campaigns at local level, organised by the most popular social networks. These will aggregate citizen preferences for particular individuals running (rigorously online only) for community leadership. Several large scale e-Voting systems will have been recognized as mechanisms for gathering preferences and casting votes (citizens will be able to cast multiple votes and also change their votes), thus creating a continuous campaigning and voting period for issues of interest, ranging from global climate change policies to urban planning and community development (e.g. train and bus schedules or prices, etc.).

Due to the high rate of technological innovation and the extremely open and transparent governance process enabled by new self-reproducing ICT-networks, (able to guarantee

users from being excluded), individual citizens are able to organise their own lives (e.g. co-designing, co-producing and co-delivering public and private services). Citizens will have two roles: first they will act as 'living sensors' capable of gathering information in all possible areas of society and second, they will exhibit a genuine 'collective intelligence' supported by easy-to-use computer-based simulation systems able to model decisions in any domain. In practice, in 2030, citizens will be able to sense and understand elements that would have escaped the archetypal politicians and specialists appointed to elaborate the solutions to given problems in the past. The collective involvement of citizens will therefore be essential not only for understanding what is happening in the real world, but also in problem solving by using the knowledge and expertise that a community, when well organized, can deploy. For example, decisions will be made in a participatory manner (using ICT-enabled mechanisms) on how to allocate the budget, how to judge suspected criminals or how to deal with any social issue of concern for the community. However, individual citizens will experience the most freedom they have ever had in the history of society. This will lead to increasing conflicts when someone's freedom interferes with someone else's, and the online dispute management system will not have enough information to decide. Conflicts will also arise between different communities (real or just virtual).

Industry and Technology

The degree of openness in terms of technological standards and source software in 2030 will be the highest ever experienced in Europe. Collaborative ICT-network systems and knowledge-sharing mechanisms will be diffused in both private and work environments (the boundaries of which will not be clearly defined as everybody will be free and able to organise themselves as to when and where they work) and this will push open innovation contexts and the development of new products and services to an extreme. However, the real application of new and innovative high technological solutions will not necessarily find interested users, who will be annoyed by continual users-tests, beta-versions, living-labs kind of experimentations, etc. Additionally, applications may not always be supported by the Internet network.

In fact, between 2010-2020, the interminable debate about the transition from IPv4 to IPv6 will have caused the rapid depletion of IP addresses. It will have been impossible to move to IPv6 as the Regional Internet Registries will have been abolished. Owners will be able to self-manage their own of Internet address-routing spaces and replicate them through network-to-network communication systems (wireless or sensor) without the need of Internet Service Providers or any technical or legal regulation. This will have lead to the establishment of millions of Self-Internet-Networks (SINs), that are in continuous communication mode, but with no pre-defined rules. Traffic will be largely controlled by hackers and bloggers who, in most cases, operate for the good of the communities, but in some cases are cyber-criminals and use their power for their own benefit. This will also have had implications for the way industries operate in the ICT sector: small and innovative start-ups will largely have replaced the big IT players. This will have increased the innovation landscape in Europe, which will be comparable to Silicon Valley in the early 2000s, but at the same time it will have contributed to the massive failure of the stock exchange systems in Europe (as mentioned above).

Privacy and Identity

In 2030, privacy will be an outdated concept studied by historians. There will be high degree of openness and pervasive technologies (developed mainly by hackers) will lead the most innovative ICT companies in Europe (mainly from the Y-generation). It will also be difficult to set boundaries between public and private life in the immersive experience of virtual communities, all interconnected and always on. This will have revolutionized the way in which personal identity

is conceived and managed. The old concept of privacy will be replaced by a sort of 'identity-as-a currency', where individuals allow transactions of their identity features in exchange for premium-services or other benefits.

Individuals and groups will take very good care of their identities. This will be done mainly by no-profit trusted third parties, who will provide identity credentials for people to use for authentication to public and private services. Privacy by design ensures that users are only engaged in the activities of public governance they are actually interested in. A system of automatic alerts, based on citizens' preferences, makes sure that they are informed of developments that interest them– environment, health, education, for instance. But, at the same time, they will be accountable for their behaviour and part of their digital persona will be visible when transactions they carry out affect other people. Not only will the digital lives of individuals be visible and commentable in editing format by default in online applications, but also any actions they carry out in real life. Mechanisms for dispute resolution will be prevalent: disputes will be resolved on online reputation management systems, where anybody can comment, post a blog, vote, recommend and give preferences, in a sort of X-factor virtual reality show.

Education and Health

By 2030, all public services in Europe will be provided by informal communities of users that organize their own communities of practices according to individual needs and preferences. Innovative ICT-enabled applications will support the combined development of narrative and formal modelling analyses. These will be dominated by leading experts (elected through campaigning and votes on social networks) and supported by technically-expert modellers and knowledge elicitation specialists. These applications will support narratives developed with social networking technology that enable participants to engage flexibly with both narrative scenarios and corresponding formal simulation models.

Traditional education systems, for example, will disappear, and be replaced by self-managed communities of learners who share information, co-build curricula and co-deliver training. However, this will lead to the creation of a myriad of competing and unharmonized training schemes and accreditation, often certified only by the communities that developed them. This will therefore make it difficult for learners to prove what skills they have when they are looking for jobs or trying to get promotion. On the other hand, the open knowledge paradigm will spread all over Europe, thus allowing for self-education, mainly for free, without the need to attend any formal courses or even schools. These will, by then, be an optional educational feature for young children (just in case some communities think this could facilitate the development of pupils' social and relational skills).

In the healthcare sector, self-governed communities of patients will organize their own health care, according to their needs by sharing experiences and self-diagnosis. The role of doctors will be limited to coordinating and facilitating online discussions and providing expert knowledge on demand, as well as acting as networking managers between patients in need of treatment and health institutions (i.e. community hospitals or specialized centres). However, technological advances will make the co-development of alternative policies aimed, for example, at reducing the impact of ageing populations on the health care systems so to make them more cost effective. In addition, anonymized aggregated data will be collected and exchanged through the communities in order to prevent and manage the diffusion of contagious illnesses, based on robust estimations and real-time data rather than on more emotional approaches, or experts' views only.

Social Cohesion and Inclusion

European society in 2030 will have a high degree of respect for diverse minorities and specific communities of carers will be available to support individuals and groups at risk of exclusion. However, the self-organisation of users will not lead to social integration and cohesion. Society will be highly diverse, with communities mainly focusing on their own interests, and excluding (digitally and in reality) individuals that do not score enough 'I like him/her'. Many communities will be closed or will admit members by invitation only. A sort of 'club society' will emerge, where advanced ICT-tools for simulation and visualization (including sophisticated immersive Virtual Worlds) will support the selection of members to be admitted according to their behaviour. This will be revealed by processing the available data from individuals' digital profiles of individuals, traceable through new 'digital shadow tracking systems'.

As a consequence, while it will appear that inclusion is guaranteed and diversity protected, European society will in fact be characterized by multiple layers of communities, sometimes mutually exclusive, and in other cases in competition or even in open conflict. It will be impossible to manage the complexity deriving from the heterogeneity of various communities, aggregating interests and users from EU member states and the global virtual communities.

Self-Service Governance Storyboard: Financial crisis – the Cassandra prediction

Amita Kataria is a world-renowned expert, responsible for monitoring and issuing early warning signals in order to prevent the occurrence of yet another financial crisis. Yesterday, she was given the highest prediction score by an online assessment system that records experts' historical statements and predictions. This system helps to identify those who are rarely mistaken. In the previous crisis, voices of those who raised the alarm were ignored or silenced (hence the title of this storyboard) - the information about the possible crash was available but society chose to ignore it. The deployment of an expert identification system has allowed better information management and consequently tighter control of the financial system.

Thanks to the advanced non-linear modelling tools that Amita uses, she is able to detect unsustainable financial exposure. These tools were developed because the traditional linear models for risk assessment used at the time of the last crisis failed to take into account the reflexive nature of this phenomenon.

Agnieszka Nowak, a member of the same online community, is known for her strategy for inducement of diversity in citizens' investment choices and management of divergent expert opinions. Other members from this community seek excessive complicity between controllers and controlled with the help of social network analysis tools (pointing out the connections between people).

Loss of trust in the banking system has resulted in the emergence of personal banking systems. Amita is no longer a client of a traditional banking system and uses instead a peer-to-peer banking system that is based on trust and not on risk assessment (e.g. hundi/hawala informal money transfer systems). Consequently, reputation tools have replaced the traditional risk management systems.

The 2009 failure to prevent the crisis was provoked by homogenous investor behaviour and by homogenous thinking by investors and monitoring institutions. Since community-managed information systems have no central information repository, there are two ways of enforcing diversity in investors' thinking. Heterogenic behaviour is generated either by providing incentives for group creation or through the diversity of information supply. Therefore, a set of recommendation tools based on previous behaviour and taste (such as Trip advisor, Amazon) with an algorithm sensitive to the divergence principle was deployed (i.e. people who like this book usually totally overlook this other well-recommended book). Concurrently, a set of divergent thinking enforcement tools (i.e. that signal excessive convergence of thinking by participants based on opinion mining) was also deployed. This enhanced dissipative behaviour of investors and also embedded in the financial system early warning signals, benefiting from large-scale translation and collaborative systems.

Moreover, due to data overload, which stemmed from the opening up of public data and also from the existence of plethora of private sources (blogs, online discussions, social networks or individual tracking system logs), there was a need for information filtering and information ranking tools. These have been developed by citizens.

As companies, governments and individuals publish large amounts of information about their investment behaviour, there is an overload of information and a growing need for privacy measures that allow data to be anonymised. Therefore a number of open data and visualisation applications were created in order to provide not only experts and analysts, but anyone with a rapid and straightforward outlook of existing investment possibilities, as well as information on the financial state of governments and private companies. Furthermore, methods of extracting knowledge from pervasive information were implemented. However, data and format standards that are necessary to ensure cross-community exchanges, are still in their infancy as the creation of any standards in such a diverse society is well-nigh impossible.

3.3 Prospective opportunities and risks

Whichever scenario dominates in the future, several challenges will need to be tackled. The direction in which research on ICT for governance and policy modelling moves will need to build on the opportunities that future ICT developments provide, and also address the risks associated with each possible scenario. In this section, we present an overview of the opportunities and risks in the scenarios in order to identify, in the following chapter, some of the key future research challenges related to ICT for governance and policy modelling and how these could drive European society in 2030.

First of all, in an **Open Governance** scenario, it is expected that people's use of the Internet will have enhanced collective intelligence (both human and ICT-enabled). The Internet will allow users unprecedented access to information and knowledge. They will be able to use policy modelling techniques and capabilities to solve global challenges and ICT-enabled tools will help them carry out their daily business and leisure-related activities, and will also open up the provision of personalized and real-time public services.

Governance processes and policy making mechanisms will be based on powerful ICT-enabled tools for simulation and visualization that will also enhance the development of intelligent systems capable of finding meaning in confusion and solving new problems, independent of human-acquired knowledge. In brief, the resources of the Internet and collective policy modelling capabilities will shift cognitive capacities, leaving the work of memorizing and processing data and information to machines, while humans focus on critical thinking and developing new analytical skills.

New literacies will therefore be required to function in a world where the future Internet might change the very notion of information and knowledge management. Users will be content creators, thus increasing the need to 'filter' data and information flows, assess quality and deal with information overload and risks of 'mass-distraction'. This will also influence the learning system of the future, which will be characterised by a mix of formal and informal education processes, and eventually increase working productivity and economic growth [EC, JRC-IPTS, 2009a]. The focus will be on the capacity to build and use social networks to help solve problems, as ICTs will more and more become an extension of individual and collective human intelligence.

In general terms, governance processes and politics will be based more on visual representation and simulated storytelling than old fashioned written texts. A sort of 'screen literacy' will therefore emerge, and ICT-enabled mechanisms for real-time representation of information and knowledge reasoning and rendering will be pivotal for communicating to citizens and integrating their feedback and arguments. These mechanisms will also explore and analyse inputs and opinions provided through different media, especially social computing and micro-blogging mobile systems, which are expected to become widespread in society [EC, JRC-IPTS, 2009a].

The online engagement of citizens and various governance stakeholders will increase and new ways of producing and sharing knowledge in an open manner will become mainstream, thus changing radically traditional governance processes and decision-making mechanisms. This will also lead to the development of an era of open innovation, thus opening up unimagined opportunities for research and technological development.

In this regard, it is expected that all institutions, public, private and third sector alike, will start listening more carefully to their stakeholders. Hence, a sort of 'molecular democracy' [Pew Internet, 2010b] will arise. Online cooperation and collaborative governance will increase becoming more functional. It will

thus avoid the possible 'Chaos Scenario' evoked by Garfield in relation to the digital age [Garfield, 2009]. Online active participation in political, educational and social activities will grow as more people are connected. People will be able to access relevant information to make informed choices online and governments will make better and more transparent decisions. This will facilitate the interaction between various stakeholders and the authorities, and governing structures of large organizations –public and private alike- will witness profound changes in power relationships. Their decision-making and governance processes will become more horizontal and participatory, as ICT tools will allow collaborative and integrated management of data and information and a shift from expert to non expert knowledge. This will increase the demand for accountability and ICT tools will permit the close evaluation of performance and consideration of the needs of multiple constituencies.

In this context, one major driver of change is expected to be the release of more public data and the development of locally-based activities to exploit the reuse and linking of data and information, rendering knowledge available and visually user friendly to the vast majority of users. Citizens, businesses and researchers will have direct access to the data and information they need and this will create new opportunities for people to interact with and influence governance and policy making processes. It will also bring advances in solving societal problems. The risk, however, will be that only the 'time wealthy' will be able to engage and thus the degree of digital divide and digital inclusion will matter in this realm especially.

The **Leviathan Scenario** assumes the emergence of an 'enlightened oligarchy' using high-tech tools and systems to collect and manage information that is only shared within the government. Judgment and decision-making is based on analytical processing of factual information with no participation of the public. This makes possible the emergence of 'Real-time governance', meaning that all aspects of government / citizen relationship (Finance, Health, Education, etc) are controlled, to the benefit of the public, e.g. Tax/salaries are not needed. All services are pre-offered, in a personalized way, without prior asking thus leading to great savings in time.

In this context, citizens trust the government, and are in favour of giving away their (voting, privacy, etc.) rights and are generally (persuaded to be) happy with the situation, as no human-caused problems exists (there are only external problems –caused by nature).

This situation could lead to a number of opportunities for society, where the 'real-time governance' system is proactively demand-driven and offers direction and services before being asked. Education, health and security are therefore radically improved. Decision-making is evidence-based and objective as it is based on analytical processing of factual information, thus no misleading, subjective information is diffused as everything is effectively controlled at central level. Emotions and thoughts are also controlled and directed towards the public good and humans are generally (persuaded to be) satisfied with their lives.

Potential terrorist attacks and pandemic diseases are eliminated in this scenario. Emergency situations are managed in the best way, and in general humans have more quality time to devote to their real interests as they do not have to waste time in schools, training or even visits / acquaintances without purpose. Industries co-operate effectively (instead of competing unfairly) as they are regulated by the state and integration and social cohesion are ensured by default. Complete reporting and processing of everything that happens in the real or virtual worlds is available for subsequent scientific research under the auspices of government.

However, this possible future is not without risks. Citizens are the passive recipients of

decisions made by information systems with the consent of an oligarchy. Due to the levels of control exercised over them, citizens have no strong feelings and may be apathetic. Freedom of will is restricted as almost everything from birth to death is predefined and pre-calculated to optimize performance.

Information overload at some point in time or potential failure of the information systems to respond to a critical, unforeseen situation would result in chaos and human beings and devices would not know how to respond. Safeguarding everything from human senses and minds to social networks of friends will eventually lead to a kind of revolution, no matter how well the intelligent systems predict human behaviour. In this scenario, Europe would become an autonomous world and freedom of circulation and travel beyond its borders would be abolished.

Citizen participation in everyday decision-making is not required or sought. A small elite sets and implements strategic policy priorities and completely controls the governance process, supported by secret national police forces. The elite models priorities according to the 'objective function' of the simulation and decision-making systems (see footnote 21). Citizen engagement tools have disappeared and social networks only serve the purpose of communicating and exchanging content. Full-scale 3D simulations and policy intelligence tools, which run automatically, facilitate decision-making – typically, the oligarchs simply approve recommendations made by these tools of the best policy option for the majority of citizens. These tools also provide services proactively in a personalized way to the human beings and autonomous ICT-enabled systems, and thus ensure the elimination of corruption and efficient resource planning and allocation.

In the **Privatised Scenario**, society is shaped by decisions which are made by a group of business representatives and thus private companies are in control of governance, not governments. Discussion on societal aspects or the role and behaviour of citizens is neglected as they are only chess pieces controlled by large corporations. Thus, any interaction with citizens and participatory mechanisms are eliminated and democracy as we know it today does not exist anymore.

This will have a number of consequences. For example, new global pandemics may spread easily because of the nomadic life style of many business people. Companies will agree on some kind of health protection for their employees, but this will not necessarily cover the vast majority of the population.

ICT-enabled modelling, monitoring, simulation and decision-support systems would be highly developed in this scenario by individual companies, but not necessarily integrated. Running billions of simulations to find the best possible alternative for decision-making will require the establishment of co-opetition mechanisms, but this will not automatically avoid risks. Simulations will be based on global data gathered by sensors and collected from continuous monitoring and analysis of networks, businesses, customers, and the whole environment. However, this data will still be fragmented and owned by corporations.

For example, integrated environmental assessment, using environmental models and impact assessment tools, will permit individual companies to develop systems that will facilitate the estimation of possible risks and optimal business strategies. However, this will require the development of sophisticated co-opetition mechanisms in order to gather as much information as possible (monitoring, sensing and spy systems) to protect their own databases and to maintain their performance in a highly competitive and hostile environment.

In this scenario, decision making is strongly dependent on the capacity of the ICT systems that facilitate decision making. Company information systems will be frequently threatened by terrorist attacks by independent groups and/or

communities. These cyber attacks can however be forecasted by running social simulations on ICT systems and thus prevented.

On the other hand, the media will be owned by, and will generally support the large corporations. They could launch false and uninformative campaigns which would make it necessary to verify all information and data made available in the media.

More importantly, ICT use will be associated with risks in, for example, health, education, energy efficiency, environmental protection and the prevention of natural disasters, despite the fact that it will also provide considerable opportunities for basic research and innovation due to the pressure of competition in a free market. In general terms, ICT advances driven by private companies are expected to reach high levels of development in areas such as teleworking, telemedicine, and early warning systems to avoid global pandemics and disasters (supported by real-time decision support systems). These will, however, be very expensive for ordinary citizens and there are high risks of exclusion. This could lead to a fragmented society where social welfare services are not guaranteed to all, thus exacerbating possible social tensions and conflicts.

The **Self-Service Governance** scenario embodies the vision of a society where citizens are empowered to take the roles of policy makers. Citizens put forward (within communities) their own policies in accordance with a do-it-yourself principle and choose from the variety of public services those they need and consent to. This is also a society where freedom of expression is perceived as the supreme value and where the agency of the individual (the capacity of individuals to act independently and to make their own choices) reigns over the structure (choices and opportunities are embedded in the system).

This scenario introduces a vision of a self-organised society (institutions are phased out) that is able to address emerging problems faster than a classically-defined government would. Moreover, it may provide disparate solutions that could prove more robust and resilient in the face of a crisis. Those who are not interested in increased autonomy and empowerment could adopt a passive 'follow the group' attitude.

Nevertheless, this diversity of opinion, stemming from the existence of closed communities, may result in the deepening of existing divides and lack of societal cohesion. There could be further exclusion of those who lack e-skills. High insularity of the society would afflict migrants most severely as they would be deprived of local social networks, and would run into communication problems due to the language and culture differences. Therefore, efficient translation tools will be developed, in order to prevent exclusion and the language and cultural divide.

In consequence, thanks to the deployment of these translation tools, a vibrant cross-cultural and multi-language society may eventually be created in this scenario. The closed communities that make up this society may flourish thanks to group thinking benefits but they may also decay due to the crowd-stupidity effect and lack of knowledge transfer. In the end, tools and functionalities may be developed that link the dissipative communities and allow for divergent thinking (e.g. 'people who like this usually totally overlook that').

Furthermore, the gradual disappearance of institutions and lack of trust in government results in the need for new trust providers. It means that reputation management, applied to both content and people, will play a significant role in service provision. Reputation tools may be delivered either by different systems depending on a community or through social pattern recognition. Moreover, an individual's identity would have different privacy layers, shared with different groups and individuals on a case-by-case basis. Additionally, authentication would be granted by communities

themselves which could result in the complete lack of internal communication and hinder the transferability of trust between people and groups.

The abundance of information produced and available online to citizens will exacerbate the problem of information overload. People will be unable to navigate through the different opinions expressed by thousands of citizens. This will restrict their focus to local networks which could increase the 'crowd stupidity' effect.

What is more, the multiplication of communities based on particular interests would make it impossible to aggregate the opinions of users from the EU Member States and global virtual communities, in turn making it impossible to address collective issues. The fragmentation of communities is likely to hinder society's capacity to tackle systemic challenges such as the scarcity of natural resources.

At the same time, there is also a possibility that the majority of citizens will not be interested in participating in governance, due to the lack of an engagement culture. Hence, new leaders could emerge who may unify disparate groups but also damage the subtle equilibrium in this collaborative culture based on self-service.

Finally, this scenario entails the end of centralised, government-controlled education. The predominance of the open knowledge paradigm paves the way to the creation of self-managed communities of learners that share information, co-build curricula and co-deliver training. Even though this new system allows an open, lifelong process of acquiring skills, it also generates a set of different competing and unharmonized training schemes and accreditation systems. Concurrently, it may incur the disintegration of common civic values, as the education system, at the moment, is an efficient government tool for building shared values.

To conclude this section, a summary overview of opportunities and risks associated with the four scenarios is presented in Table 3.1.

Table 3-1: Prospective opportunities and risks

Scenario	Opportunities	Risks
Open Governance	• Possibility of leveraging data and knowledge management through integrated and trusted systems enabling real-time collaboration • Participatory and all inclusive models of governance representing the interests of all stakeholders and guaranteeing effective allocation of public resources • Evidence-based policy design and implementation based on appropriate needs analysis and citizens' expectations, thus increasing quality of services and users' satisfaction • Increased collaborative decision-making, policy-implementation, monitoring and evaluation of results • Better defined policy options mechanisms and more efficient allocation of resources • Seamless / cross-organisation / cross border data portability/exchangeability improves quality of digital living	• Participatory policy mechanisms pushed to an extreme could lead to paralysis of governance processes, increased time and cost of policy-making thus reducing policy impacts • Losing track of ‚digital shadows', which could affect real-life reputational mechanisms • Weakening societal structure due to loose reference points and power-balance • Multiplication of digital personae and virtual-transactions, which could make it difficult to support evidence-based policy making mechanisms • Increased threats from misuse of data, user vulnerability and cybercrime growth • Increased cost of service-delivery due to the need for multiple-user targeting • Some citizens will distrust government, leading to tensions and reduced participation • Blurred and ineffective role-structures could lead to competing/conflicting situations (e.g. non-digital rebels) • Open society vs. class society

Scenario	Opportunities	Risks
Leviathan Governance	• Real-time governance that is proactively demand-driven offering direction and services before being asked • Decision-making is evidence-based and objective, based on the analysis of factual information • No misleading, subjective information is diffused as everything is effectively controlled at central level • Potential terrorist attacks and pandemics are eliminated. Emergency situations are managed in the best way • Humans have more quality time to devote to their real interests • Industries co-operate effectively as they are regulated by the state • Integration and social cohesion are ensured by default • Complete reporting and processing of everything that happens in the real or virtual worlds is available for subsequent scientific research under the auspices of government	• Citizens are the passive recipients of decisions made by information systems with the consent of an elite. Due to the levels of control exercised over them, they have no strong feelings and are often apathetic • Freedom of will is restricted as almost everything from birth to death is predefined and pre-calculated to optimize performance • Information overload at some point in time or the potential failure of information systems to respond to a critical, unforeseen situation will result in chaos where human beings and devices will not know how to respond • Safeguarding everything from human senses and minds to social networks of friends will eventually lead to some kind of revolution, no matter how well the intelligent systems predict human behaviour • Data-control/digital supervision, tracing and tracking of digital transactions could lead to increasing digital censorship • Europe could become an autonomous world in which freedom of circulation and travel outside its borders is abolished
Privatised Governance	• High development of ICT-enabled data and information management systems in support of decision making • Development of co-opetition mechanisms in the private sector • Increased efficiency and effectiveness of service delivery • Enhancement of private research and development capacities, possibly leading to higher innovation • More effective and efficient deployment of ICT networks • Economic growth and quality of life could be increased for people that have enough resources to participate	• Virtual policy making mechanisms that may be not representative of real-life situations and not inclusive • Risk of 'de-democratisation' • 'Techno-elitist' and not inclusive policy-making mechanisms could lead to increasing digital exclusion • Risk of 'failure' of the ICT systems, increased by high security threats • Privacy invasion threats • Possible exacerbation of social tensions and conflicts • Innovation processes may be hampered by lack of collaboration and pervasiveness of patent rights
Self-Service Governance	• Self-organised society addresses problems faster and provides more diverse answers • Freedom of expression as the supreme value • End of centralised, government-controlled education, diverse and robust education system, lifelong learning systems for workers • The individual's capacity to choose is incorporated in the system • Do-It-Yourself policies, citizen as a policy maker • Cross-cultural and multi-language society • Emergence of new leaders who unify disparate groups • Different layers of privacy	• Diversity might result in deepening divides and lack of cohesion. It would be impossible to aggregate opinions and address collective issues. Walled garden communities – high insularity • Lack of capacity to address systemic issues due to fragmentation • Exclusion – digital divide, language divide, marginalisation of migrants • Information overload • Some citizens would not engage and simply remain in their own group because of the lack of engagement culture • Emergence of new leaders who could harm self-service governance and the collaboration system • Identity scattered on the web

4. Conclusions

4.1 A vision for Digital Europe 2030

In this section, we propose a vision of Digital Europe 2030 - a society where ICT for governance and policy modelling could play a significant, positive role.[18]

In the coming years, the Internet will move beyond being a network of computers and become a network that connects everything to everything else: cars, machines of all sorts, household appliances, energy meters, windows, lights, people, businesses, personal and medical data. This new 'Internet of Things' has two important implications. First, this new global web of 'things that think' will rest on a sensory network that will enable a leap forward in structured, usable knowledge about the world we live in. It will support energy efficiency, and the provision of health and welfare services and efficient transport. If it is done well, a massive improvement in our quality of life and sustainability will follow. Second, these new applications provide new business opportunities, under the heading of the 'Internet of Services'. This will be based on virtualisation, cloud computing and other technologies which will emerge and will be complementary to user-enabled technologies, applications and values (e.g. social computing), with open APIs, There will be a need to develop innovative business models and public-private partnerships to cope with the potential and challenges it will bring about. Open standards, technologies and applications will therefore play a crucial role: they will be embedded in any network system, enabling both service and data portability and seamless navigation with any technological support, wherever and whenever. Artificial intelligence will support the evolution of innovative and effective real-time monitoring, support systems and agents. It will be directly connected or bound to humans in order to augment their perception and capacities, thus realising the long held ambition to augment reality and give humanity a 'Smart Ambient Living Space' or 'Social Ambient Intelligent' environment.

In the new service-oriented web, user-enabled ICT applications will be integrated in a seamless environment with sensor networks, semantic technologies and service-oriented architectures, where user participation and empowerment will be crucial for the development of new applications and their effective use in everyday life. The increasing market demand for emerging and evolving collaborative technologies shows that these can transform - economically, politically and socially - the way private and public services are organized and delivered. The wide range of implementations at European and global level can be seen as a clear driver of further change in the future. However, user-enabled ICT applications will take time to filter through into business and public services. Ongoing change, supported by social computing, in the ways organisations work and business is carried out will need a mentality change and a cultural innovation which will require in turn a more structured redefinition of rules and mechanisms in the years to come. The transition phase from old to new approaches, in which both will coexist, will be a challenge, as will the capacity of citizens and governments to manage the disruptive impact and the risks that may arise if it is not properly governed.

In parallel to successful applications of user-enabled ICT applications and policy intelligence mechanisms, more fundamental innovations in business models, value chain concepts and user/

18 A draft version of this vision statement was discussed during the CROSSROAD Workshop that took place in Seville at IPTS on 29 – 30 April 2010. Additionally, it was made available to experts for review and online for public comment. It can therefore be considered the shared vision of the CROSSROAD community.

producer relations are needed to generate the leapfrog in innovation, typical of collaborative and open applications. These innovations are already visible and will become more and more embedded into business models and practices in the private sector which is embracing the new culture of the open and collaborative web either as a 'survival strategy' (as in the media sector) or to increase competitiveness. The dynamics of the open web will in fact radically modify the way business is done in many contexts. In the near future, companies will start to use participatory tools, first within organizations, and then open them up to their customers on the web. This will generate a high potential for Open Innovation to take place on an everyday basis. Crowdsourcing will become an established phenomenon in management practice, and firms will incorporate open source principles (based on social computing and open source) into their business models, as an effective diversification strategy to gain and sustain competitive advantages, in the context of a globally interconnected society. Virtual platforms such as today's Facebook or Myspace will be widespread and interconnected, becoming more and more interoperable, with data exchange via secure networks, and will be available through open applications and systems.

The majority of firms in the future will make use of a 'loose' intellectual property regime to extend their operations outside the formal boundaries of the organization, and orchestrate knowledge work via informal globally distributed communities of practice. As an example, there may be an ever-growing borderless state for ICT operations, in which CIOs will source their ICTs from global offshore locations or suffer competitive disadvantage. The need for global sourcing will also extend to the 'best' combinations of everything we need and wish to do. No nation state, not even the EU, will be able to draw a line around itself and declare that 'this is ours to control'.

The open, decentralised and user-driven organisational models of emerging ICT applications will provide new tools and paths for innovation, which has up until now been hard to achieve and disseminate in the public sector. This could be an opportunity for innovation, especially as regards the future generation of civil servants and the changing role of the state, particularly in areas where gathering, using and interacting with citizens' input can create public value in terms of enhanced democratic processes, policy and regulatory development and increased quality of service delivery. Communities of interest and practice constitute a key building block in this process as they provide arenas for deep conversations in all areas of life. Governments have not yet learned how to leverage the power of these communities in all the areas in which they have a mandate, and to do so, they will have to open up to non-government expertise and resources. ICT-enabled governance mechanisms and policy-modelling toolkits will provide connection, deliberation, forecasting and processing modules. This could create genuine political commitment which would exploit a large number of engagement methodologies, many of which already exist in other sectors such as gaming and open source, and would lead to profound changes in the roles and powers of government.

An important development in future decision-making will rely on highly distributed reputation-based governance mechanisms. These are ICT-enabled organisational forms, characterized by an unprecedented degree of transparency and by allocation of resources and power strictly linked to past performances and to the reputation that derives from them. This would bring about important changes in the availability of governance-related statistics. If all business, government and other stakeholder processes are carried out online, governance-related information could be automatically retrieved and analysed. In the years to come, reputation-based governance could provide a distributed platform on which to implant innovative procedures, reputation-based themselves, that will allow citizens to participate in the design of policies and in how they are implemented.

For this to happen, public sector data must be effectively 'liberated' and standards for

information and data exchange defined so that public information can be made available and re-used by non-governmental actors, while citizens' rights are preserved. The deepening of Freedom of Information (FOI) and Reuse of Public Sector Information principles will transform the role of governments which will move towards providing reliable data or regulating how data are handled through third-party agencies. Data will be reused by individuals or other organizations through web application hybrids (mashups), personalized and contextualized to specific needs. This will greatly facilitate citizens' lives as they will be able to carry out their daily activities seamlessly, using basic information which will be available 'on demand' and secured through a distributed access network. This will also open up opportunities for business development in this field.

This will affect the public and the private sector equally. The role of technology and user-enabling applications in particular in this will be critical. It implies a new way of thinking, with a revolution in the way business is done. The workforce will change, and young employees are already demanding a very different world. It is not just about ICTs: it represents a fusion of a vast range of technologies, products, services, and most importantly, a life style change. In fact, as the current young generation moves into management roles, one can expect radical changes in the coming 10-20 years in how businesses are run and public services are managed.

Moreover, we should consider further technological innovations: in particular, the unprecedented technological development of mobile applications, exceeding the diffusion rates of technologies such as television or even pen and paper not only in terms of penetration and use but also in speed of take-up, and future possibilities (which include the consolidation of broadband internet-enabled wireless networks such as LTE or WiMAX, as well as the integration with RFID readers, GPS/location-based technologies and near field communications capacities developments). All this will multiply the take-up and use of collaborative ICT for governance and policy modelling mechanisms to new applications and purposes, opening up access and enabling more users to engage. As a consequence, the potential uses and benefits for both the public and private sector will increase exponentially, giving individuals and groups the possibility to express themselves and participate actively in the building of the European and global Knowledge Society in 2030.

4.2 Future research challenges

In this section, a brief analysis of the future research challenges and directions that emerge from the overall study are outlined.[19] This analysis is intended to guide the composition of the CROSSROAD Roadmap for future research on ICT for governance and policy modelling, in order to achieve the most desirable components of future possible scenarios and avoid the less desirable ones.

In general terms, we should underline that the Internet as we know it today, is already a remarkable catalyst for creativity, collaboration and innovation providing us with amazing possibilities that would have been impossible to imagine just two decades ago. Tim Berners Lee invented the Web only 20 years ago, and two years later the CERN publicized the new World Wide Web project. Back then, if one had told people that in 2010 even a child would be able to access for free a satellite image of any place on earth, interact with other people from everywhere and query trillions of data all over the globe with a simple click on his/her computer, they would have said this was science fiction [EC, 2009e].

Today, CROSSROAD's Scenario Design sets out to prepare a similar trip into the future. The scenarios developed for Digital Europe 2030 aim

19 This analysis takes into consideration the comments provided by experts during the CROSSROAD's Validation Workshop (IPTS, Seville, 29-30 April 2010), as well as relevant inputs received from the online public consultation (see www.crossroad-eu.net).

to define a vision of how governance and policy modelling could develop twenty years from now, so as to identify what research needs should be addressed by the research community. Indeed, challenges in the emerging domain of ICT for governance and policy modelling are huge and complex and cannot be dealt with in isolation. In this regard, there is also a strict relationship with the broader task of envisioning and developing the Future Internet. The Internet was not originally designed to serve massive scale applications with guaranteed quality of service and security. Emerging technologies like streaming high quality video and running 3D applications, or, in our specific domain, applications that enable mass collaboration, data processing, simulation and visualization through complex modelling, face severe constraints as regards running seamlessly anytime, everywhere, with good quality of services.

European scientists have proved they are at the forefront of ICT research since the invention of the web and throughout the rapid technological developments of the last 20 years. It is now time to bring together different research disciplines that could help us benefit from the opportunities of ICT for better governance and policy modelling, and at the same time overcome the possible risks to society of mainstreaming large scale applications in this domain. Additionally, and from a technological infrastructure perspective, we should remember that the current Internet, as an ubiquitous and universal means for communication and computation, despite being extraordinarily successful so far, has a series of inherent unresolved problems. It is expected that it will soon reach its limits as regards both architectural capability and capacity (i.e. in addressing, in reachability, new demands for quality of service, service and application provisioning, etc.) [EC, 2009e].

However, the future development of Internet infrastructure will be supported by complementary advancements in technological applications that are now consolidated trends and expected to grow even faster. The groundwork that has been in place for years now should yield innovation anytime in the near future [Pew Internet, 2010a]. More powerful devices, even cheaper netbooks, virtualization and cloud computing (including portable solutions), reputation systems for social networking and mass collaboration tools, as well as the proliferation of sensors, reporting and decision-support systems, do-it-yourself embedded systems, robots, sophisticated algorithms for processing data and performing statistical simulation and analysis, visualization tools to report results of these analysis, affective technologies, personalized and location-aware services, facial and voice recognition systems, electronic paper, anomaly-based security monitoring, self-heating systems and others are expected to become reality and mainstream in the next 10-20 years.

But far more important than network requirements and technological applications is the consideration of socio-economic aspects in the development of future ICT tools for governance and policy modelling. Socio-economics as a multi-disciplinary field, which cuts across all research areas of the ICT for governance and policy modelling domain, has manifold research challenges. Suitable governance and policy-making mechanisms, which provide appropriate incentives for participation, but at the same time ensure security and avoid risks (of enlarging digital exclusion, for example), need to be designed.

Moreover, legal and regulatory issues such as digital rights, privacy and data protection, also have to be taken into consideration, as the demand for the establishment of trust in governance may increase (or shift) as its usage scenarios change. For example, an ever-increasing openness of ICT-enabled governance and policy modelling mechanisms, and the criticality and value of the transactions conducted over the open platform used for this purpose, may create incentives for malicious use of data and information. While security technologies will be developed to address the technological challenges linked to this, additional risks to trust arise in the domain under investigation, mainly due to its potential pervasiveness, large scale and involvement of users.

The challenges include, for instance, the design of identity management systems capable of dealing with billions of entities, and their different roles in the governance sphere, the trustworthiness and control of distributed applications based on services offered through open service delivery platforms, and the secure and trusted interaction with real-world objects and entities through sensors and actuator network infrastructures [Pew Internet, 2010a].

More specifically, for example, the emergence of wireless networks could allow software applications and physical objects to be connected, opening up a wide range of exciting new application scenarios in governance and policy modelling. At the same time, however, the same openness underpinning their mass-development and usage will expose sensor networks and related information and content to possible attack and misuse.

The opportunities provided by future ICT tools for governance and policy modelling for individuals, businesses and governments are huge but they will only be taken if appropriate conditions and 'governance models' are developed. In fact, it is expected that ICT tools for governance and policy modelling will force change in institutions, no matter how resistant they are. And even if it could be predicted that governments that redefine their relationship with their stakeholders will be the ones to succeed, the market will still drive that process in the commercial domain, and tensions may emerge as stakeholders know more and more about the organization that are trying to serve them [Pew Internet, 2010b].

In the longer term, it can also be expected that governments will embrace more 'networked-governance' structures. Nonetheless, a struggle will unfold between traditional bureaucratic systems and network-based mechanisms as to which is the best way to organize people, knowledge and service delivery. As a matter of fact, changes in governance structures and processes may well occur in phases in response to pressures brought to bear by new ICT tools and emerging societal behaviours.

At the same time, it seems that increasing demand from the scientific and business community, as well as from civil society organizations and citizens groups, will drive the emergence of 'experimentally-driven research', to address broad governance and policy-making challenges, developing and applying ICT tools and applications to exploit the full value of the mass collaboration and open and participatory paradigm underpinning the future technological developments and governance directions in Europe. This would eventually allow the testing of new ICT-based solutions and models for collaborative governance and participatory policy modelling, and socio-economic impact assessment of future societal changes.

This last issue entails building on the momentum that the domain of ICT for governance and policy modelling has recently gained, by developing the CROSSROAD community. In order to further bridge the gap between various stakeholders and long-term research and large-scale experimentation, enabling cross-fertilization across different scientific disciplines and integration of resources, special emphasis should be put on fostering common research results.

This will create value for the EU community concerned, avoiding fragmentation of research efforts and it should also include the experiences gained at the international level. This requires developing a joint strategic research agenda, on ICT for governance and policy modelling to support the building of an open, innovative and inclusive Digital Europe 2030.

To sum up, based upon the analysis conducted as part of the CROSSROAD Scenario Design exercise, and considering the main findings discussed with Experts during the CROSSROAD Workshop in Seville, a number of research challenges associated with ICT tools that may be required in the future have been identified (see Table 4.1). Their relations with the Research Areas defined by the CROSSROAD taxonomy are also pointed out [CROSSROAD 2010a].

Table 4-1: Future research challenges

Challenge	ICT tools	Research Areas
Enhanced collective cognitive intelligence (human/ICT-enabled) for better governance and policy-making	Tools for large scale information and knowledge filtering and management Collaborative Policy, analysis, simulation and visualisation tools Reputation-management mechanisms and tools Identity management, privacy and data protection and trust assurance systems 'by design/default' Tools for automated integration / link of data, knowledge reasoning and representation for rendering results	1.1. Open and Transparent Information Management 1.2. Linked Data Management 1.3 Visual Analytics 2.1 Social Computing 2.2 Citizen Engagement 2.3 Public Opinion Mining and Sentiment Analysis 3.1 Policy Analysis 3.2 Modelling and Simulation 3.3 Visualization 4.1 Identity Management 4.2 Privacy 4.3 Statutory Framework for Trust 5.1 Cloud Computing 5.2 Pervasive Computing and Internet of Things in Public Services 5.3 Multi-channel Access and Delivery of Public Services 5.4 Future Human / Computer Interaction Applications and Systems
Unique identification and real-time state and basic indications-properties monitoring of all physical and virtual entities	Sensor systems: Internet of Things (IoT) Real-time context-aware and secure services addressed to humans and things Massive data manipulation from ubiquitous devices: IoT / Sensors / High resolution space sensors cameras / surveillance systems Visual analytics tools able to integrate / correlate / present information in real time Real time, adaptive, self-optimising forecasting/ backcasting, full-scale simulation for decision making Massive scalability and processing power in public government clouds Seamless automation and interoperability between Internet of Things, Internet of Services and Internet for and by People	1.3 Visual Analytics 2.3 Public Opinion Mining and Sentiment Analysis 3.1 Policy Analysis 3.2 Modelling and Simulation 3.3 Visualization 4.1 Identity Management 4.2 Privacy 5.1 Cloud Computing 5.2 Pervasive Computing and Internet of Things in Public Services 5.3 Multi-channel Access and Delivery of Public Services 5.4 Future Human / Computer Interaction Applications and Systems
Collaborative and automated decision making and risk management	Co-opetition supporting tools Argumentation analysis tools Decision support tools (that incorporate cost of not participating) Negotiation systems Resources monitoring systems (e.g. consumption control, sensors) Low cost sensing technologies Resources planning and coordination systems Automated risk management systems Data security and protection technologies	3.1 Policy Analysis 3.2 Modelling and Simulation 4.1 Identity Management 4.2 Privacy 4.3 Statutory Framework for Trust
Collaborative and sense-based communication	Collaboration tools Tele-work solutions and distributed management systems Distributed sensing tools Telecommuting (high fidelity, low cost, high data security, high protection against disruptive attacks) Robotics Crisis management systems	1.1. Open and Transparent Information Management 1.2. Linked Data Management 1.3 Visual Analytics 2.1 Social Computing 3.1 Policy Analysis 3.2 Modelling and Simulation 5.4 Future Human / Computer Interaction Applications and Systems

Challenge	ICT tools	Research Areas
Language divide and lack of cross-communities communication	Translation tools	2.2 Citizen engagement
Anticipating unexpected crisis	Non-linear models taking into account societal implications	3.2 Modelling and Simulation
Stimulate divergent thinking	Anti-crowds sourcing tools or extensive consensus signals based on opinion mining	2.1 Social computing
	Algorithms based on individual preferences, recommendation tools and collaborative filtering tools	2.1 Social computing
Answering to the information overload	Collaborative filtering tools and Information certification systems and information ranking tools	2.1 Social computing
	Expert identification system and reputation management tools	2.1 Social computing
	Context-aware applications that provide relevant information based on the users' context	2.1 Social computing
	Visualisation tools that help navigating information overload, for both expert and lay people	3.3 Visualization
Privacy and trust	Reputation management tools	2.1 Social computing 4.1 Identity Management 4.2 Privacy 4.3 Statutory Framework for Trust
	Federated Identification through social relations recognition or different community systems	2.1 Social computing 4.1 Identity Management 4.2 Privacy 4.3 Statutory Framework for Trust
Cross-community bridging	Application enabling trust and reputation propagation from one local network to another	2.1 Social computing 4.1 Identity Management 4.2 Privacy 4.3 Statutory Framework for Trust
Spatial planning and social inclusion	Modelling tools for anticipating social conflicts that include and take into account human emotions	3.2 Modelling and Simulation

4.3 Towards a roadmap on ICT for governance and policy modelling

In this final section, in view of the key challenges that we expect governance stakeholders and policy makers will have to face in the next 20 years, highlighted in this report, and after discussion with experts and stakeholders, we present a preliminary overview of possible research directions which may contribute to the shaping of the CROSSROAD Roadmap for future research on ICT for governance and policy modelling.

In the coming years, conventional wisdom and familiar governance models will be challenged as ICT-based disruptions impinge on democratic, consultative and policy-making processes. Evidence already gathered anticipates that the scope and scale of transformation will have a major impact on society [Broster, 2007]. Since 2005, in fact, there has been a phenomenal growth in mass, on-line collaborative applications, which has captured the imagination and creative potential of millions of participants - particularly the young generations. In addition to new forms of leisure pursuits, community-building activities have also entered the political arena as witnessed in a number of recent national elections [EC, JRC-IPTS, 2009a, 2009c, 2009d].

Online communities can leverage considerable human knowledge and expertise and rapidly build their capacity. At the same time, it is now recognised that online collaborations have the potential to trigger and shape significant changes in the way future societies will function. Extrapolation of the present exponential growth leads to scenarios where a very large percentage of the population could, if equipped with the appropriate ICT tools and capacities, simultaneously voice opinions and views on major and minor societal challenges, and thereby herald the transition to a different form of dynamically participative governance models.

While such scenarios are readily imaginable, we also recognise that we currently do not have appropriate governance models, process flows, or analytical tools with which to properly understand, interpret, visualise and harness the forces that could be unleashed. Present government processes (local, regional, national and EU level) provide laws and regulations, interpret and define societal norms and deliver societal support services. Their legitimacy is derived through democratic processes combined with a requirement for transparency and accountability. In a world that is increasingly using non-physical communication and borderless interaction, the traditional roles and responsibilities of public administrations will be subject to considerable change and classical boundaries between citizens and their governments will be increasingly blurred. The balance of power between governments, societal actors and the population will have to adapt to these challenging new possibilities.

A key issue will therefore be to develop and apply advanced ICT tools to provide robust support to the change process and herald the transition to a new digitally-derived legitimacy. Inherent in this process is the definition and realisation of new, carefully crafted governance models. By 2030, there will no longer be any barriers which prevent citizens and businesses from participating in decision making at all levels, and hence the present democratic deficit will be overcome. Advanced tools – possibly building on gaming and virtual reality technologies - will enable citizens to track the totality of decision making processes and see how their contributions have been (or are being) taken into account. Current linguistic and cultural barriers will have been largely overcome through use of semantic-based cooperation platforms [Broster, 2007].

Opinion mining, visualisation and modelling into virtual reality-based outcomes and scenarios will help to both shape, guide and form public opinion. These ICT-enabled processes and tools will have to demonstrate transparency, earn

people's trust and be devoid of manipulation. The outcomes of such consultative processes should be faster and more efficient policy revision and decision making.

By 2030, it is expected that transparency and trust in governance processes and policy making will characterise a changed relationship between governments, businesses and citizens. Governments traditionally collect, process and store significant quantities of data. In the future, the relationships will change and businesses and citizens will be in a position to 'authorise' access by governments to 'data spaces' of their own data which they control and update. Such a scenario would result in a 'private shared space' jointly accessed by data users and data providers. Equivalent data spaces will be adopted by businesses. These shared spaces will require extremely robust access rules and procedures and hence new technologies and ICT tools that ensure privacy and data protection. Trust in such technologies will need to be earned [EC, DG-INFSO, 2009].

In most organizations, information travels along familiar routes. Proprietary information is lodged in databases and analyzed in reports and then rises up the management chain. Information also originates externally: gathered from public sources, harvested from the Internet, or purchased from information suppliers. But the predictable pathways of information are changing: the physical world itself is becoming a type of information system. In addition to this, more objects are becoming embedded with sensors and gaining the ability to communicate. The resulting information networks promise to create new opportunities, improve governance processes, and reduce costs and risks of policy decisions. In what is called the Internet of Things, sensors and actuators embedded in physical objects -from roadways to pacemakers- are linked through wired and wireless networks, often using the same Internet Protocol (IP) that connects the Internet. These networks churn out huge volumes of data that flow to computers for analysis. When objects can both sense the environment and communicate, they become tools for understanding complexity and responding to it swiftly. What is revolutionary in all this is that these physical information systems are now beginning to be deployed, and some of them even work largely without human intervention [EC, 2009e].

The widespread adoption of the Internet of Things will take time, but the time line is advancing thanks to improvements in underlying technologies. Advances in wireless networking technology and the greater standardization of communications protocols make it possible to collect data from these sensors almost anywhere, any time. Ever smaller silicon chips for this purpose are gaining new capabilities, while costs, following the pattern of Moore's Law, are falling. Massive increases in storage and computing power, some of it available via cloud computing, make number crunching possible on a very large scale and at decreasing cost [Chui et al., 2010]. Research in the area of the Internet of Things is now in fact strictly linked to advances in the field of Ubiquitous Networks and pervasive computing. Future applications are opening up huge opportunities for private and public sector organizations alike. Despite the fact that many of the technologies which underpin the future Internet infrastructure are not new (e.g. Radio Frequency Identification, sensor networks, GRPRS, UMTS Hsdpa and Near Field Communication, to mention a few), the conditions for their application may result in innovative and disruptive usages on a daily basis in forthcoming years [Pew Internet, 2010a]. This innovation could support several public policies, such as logistics, security, transport, environment and energy, education and health, and many others [Medaglia, Chicca, Orlando, 2010].

Future research directions to harness the potential of ICT for governance and policy modelling could therefore include – but not necessarily be limited to – the following fields of application:

✓ **Information management and analysis to monitor and simulate in real time the behaviour of real and virtual entities (people, things, information and data) -** as future ICT networks will link data from any object and person, or the operating environment they are placed in, they will generate better information and analysis, which can enhance decision making significantly.

Some organizations (mainly in the private sector) are starting to deploy these applications in targeted areas, while more radical and demanding uses are still in the conceptual or experimental stages. For example, when objects are embedded with sensors, companies can track the movements of these objects and even monitor interactions with them.

ICT applications can be fine-tuned to take advantage of this behavioural data. Some insurance companies, for example, are already offering to install location sensors in customers' cars. This allows these companies to base the price of policies on how a car is driven as well as where it travels. Pricing can be customized to the actual risks of operating a vehicle, rather than basing it on proxies such as a driver's age, gender, or place of residence. Similar applications may be developed in various governance domains - for example, to support social care policies, transport, energy or others.

In addition to this, ICT tools and technologies to animate large-scale societal simulations that forecast potential outcomes and impacts of proposed policy measures could be developed. These could include simulating the impacts of the movement of people, commuters, goods and services, jobs, costs, benefits, social impact and resulting social burdens.

The public sector could use these tools to examine options based on the simulated behaviour and wishes of individuals, groups or society as a whole to understand the possible outcomes of policy proposals, legislation, and implementation options.

✓ **Enhanced real-time situational awareness for tracking, policy modelling, and visualisation -** data from large numbers of sensors, deployed in physical infrastructure (such as roads and buildings) can report on environmental conditions (including soil moisture, ocean currents, or weather), and give decision makers a heightened awareness of real-time events, particularly when the sensors are used with advanced display or visualization technologies.

In addition, the range of possible uses for tracing and tracking technologies is also expanding. For example, the use of advanced ICT tools for tracking could be used for security and to optimize transport planning and implementation, preventing and managing eventual disasters to reduce environmental impact. Security personnel, for example, can use sensor networks that combine video, audio, and vibration detectors to spot unauthorized individuals who enter restricted areas.

Some advanced security systems already use elements of these technologies, but more far-reaching applications are being developed as sensors become smaller and more powerful, and software systems more adept at analyzing and displaying captured information.

Logistics managers for airlines and trucking lines are already tapping into some of the early capabilities and are getting up-to-the-second knowledge of weather conditions, traffic patterns, and vehicle locations. In this way, these managers are increasing their ability to make constant routing adjustments that reduce congestion and therefore costs and increase a network's effective capacity.

In particular, research in the area of processing and management of the vast reserves of Europe's public sector collective data and knowledge resources should be promoted.

✓ **Policy intelligence and ICT-driven decision analytics -** the future Internet infrastructure is expected to support longer-range, more complex human planning and decision making. The technology requirements -tremendous storage and computing resources linked with advanced software systems that generate a variety of graphical displays for analyzing data- rise accordingly. In the oil and gas industry, for instance, the next phase of exploration and development could rely on extensive sensor networks placed in the earth's crust to produce more accurate readings of the location, structure, and dimensions of potential fields than current data-driven methods allow. The payoff consists of lower development costs and improved oil flows, and avoiding risks of natural disasters such as the one witnessed in 2010 in the Gulf of Mexico, for example.

In health care, sensors and data links offer possibilities for monitoring a patient's behaviour and symptoms in real time and at relatively low cost, allowing physicians to better diagnose disease and prescribe tailored treatments. Patients with chronic illnesses, for example, have been fitted with sensors in a small number of health care trials currently under way, to monitor their conditions continuously as they go about their daily activities. One such trial has enrolled patients with congestive heart failure. These patients are typically monitored only during periodic visits to the physician's office for weight, blood pressure, and heart rate and rhythm. Sensors placed on the patient can now monitor many of these signs remotely and continuously, giving practitioners early warning of conditions that would otherwise lead to unplanned hospitalizations and expensive emergency care. Better management of congestive heart failure alone could reduce hospitalization and treatment costs by a billion Euros annually in the EU [Codagnone, 2011, forthcoming]. In this context, semantic web applications to access and visualise background knowledge repositories to the public, as well as the optimisation of ICT tools to facilitate automated translation, process modelling, data mining, pattern recognition and visualisation and other gaming-based simulation, forecasting and back-casting, and goal-based optimisation techniques should be promoted.

✓ **Automated mass collaboration platforms and real-time opinion visualisation -** here, ICT tools and technologies build on and extrapolate from social computing and future collaborative technologies, to facilitate bottom-up, user-controlled, massive social collaboration and networking applications. They incorporate mixed reality applications based on semantic cooperation platforms that traverse language and cultural interpretation thereby enabling multi-national groups to create, learn and share information and knowledge. Also included are technologies and tools to embody structural, organisational and new collaborative governance models and processes that enable groups to form, engage, create, learn and share and track group knowledge creation may also be promoted.

Complementary ICT tools to support virtual community opinion forming, incorporating: simulation, visualisation and mixed reality technologies, data and opinion mining, filtering and consolidation should also be developed. Citizen participation implies the ability to track the whole public sector decision-making process and see whether and how contributions have been considered. These ICT tools should, however, address identity management and authentication systems to ensure delineation of constituency domains where appropriate, in view of privacy concerns. The scale and complexity of the governance action, and its technical intertwining between various stakeholders in society, set quite unique requirements for trust and liability, prevention of unauthorised access, misuse and fraud. ICT tools must therefore be able to encompass multiple identities, pseudonymity, authentication, secure data disposal, etc.

✓ **ICT-enabled data and process optimisation and control -** making data the basis for automation and control means converting the data and analysis collected through virtual

machines into instructions that feed back through the network to actuators that in turn modify processes. Closing the loop from data to automated applications can increase the efficiency and effectiveness of governance processes and service delivery, as systems that adjust automatically to complex situations make many human interventions unnecessary.

Early adopters are ushering in relatively basic applications that provide a fairly immediate payoff. Advanced automated systems will be adopted by organizations as these technologies develop further. For example, the deployment of the future Internet infrastructure is opening up new frontiers for improving processes.

Some industries, such as chemical production, are installing legions of sensors to bring much greater granularity to monitoring. These sensors feed data to computers, which in turn analyze them and then send signals to actuators that adjust processes - for example, networked sensors and automated feedback mechanisms can change usage patterns for scarce resources, including energy and water, often by enabling more dynamic pricing.

Utilities such as ENEL in Italy and Pacific Gas and Electric (PG&E) in the United States, for example, are deploying 'smart' meters that provide residential and industrial customers with visual displays showing energy usage and the real-time costs of providing it.

✓ **Complex dynamic societal modelling systems -** the most demanding use of computing capacities in the future will involve the rapid, real-time sensing of unpredictable conditions and instantaneous responses guided by automated systems. This kind of machine decision making mimics human reactions, though at vastly enhanced performance levels.

The automobile industry, for instance, is stepping up the development of systems that can detect imminent collisions and take evasive action. Certain basic applications, such as automatic braking systems, are available in high-end cars. The savings that could be made through accident reduction, if this application is widely deployed, could exceed 100 billion Euros annually.

Some companies and research organizations are experimenting with a form of automotive autopilot for networked vehicles driven in coordinated patterns at highway speeds. This technology would reduce the number of 'phantom jams' caused by small disturbances (set off, for example, by suddenly illuminated brake lights) that escalate into traffic bottlenecks.

Scientists in other industries are testing swarms of robots that could maintain facilities or clean up toxic waste. They are also studying systems for the defence sector which would coordinate the movements of groups of unmanned aircraft. While such autonomous systems will be challenging to develop and perfect, they could improve safety, reduce risks, and cut costs. These experiments could also spur fresh thinking about how to tackle tasks in inhospitable physical environments (such as deep water, wars, and contaminated areas) that are difficult or dangerous for humans.

Some of these technologies are already expected to be on the frontier of adoption in the next years. As they mature, the range of deployments in support for governance and policy-making will increase.

Research should therefore be promoted across various disciplines in order to structure ideas about the potential impact and opportunities likely to develop in the future. This will involve, for instance, the need to improve software to aggregate and analyze data, as well as graphic display techniques, to the point where huge volumes of data can be absorbed by human decision makers or synthesized to guide automated systems more appropriately.

Bibliography

Aarts, E.; Marzano, S. (Eds.) (2003). The New Everyday: Views on Ambient Intelligence. Rotterdam: 010 Publishers.

Aicholzer, G., (2005). Scenarios of eGovernment in 2010 and implications for strategy design, in: Electronic Journal of e-Government Volume 2 Issue 1 (1-10).

Boix Alonso, L., (2010). Deputy Head of Cabinet of European Commission's Vice President Neelie Kroes, Towards the European Digital Agenda: Challenges and main policy issues, Presentation to the EuroCPR 2010 conference: Policies for a digital Europe, Brussels, 28-30 March.

Braun, A., Boden, M., Zappacosta, M., (eds), (2003). Healthcare Technologies Roadmap, The Effective Delivery of Healthcare in the Context of an Ageing Society, Working Document, http://esto.jrc.es/docs/HealthcareTechnologiesRoadmapping.pdf

Broster, D., (2007). A briefing paper for research at EU level on eGovernance and eParticipation – in support of an eSociety (EC, DG-INFSO Working paper, (Unpublished) December.

Cahill, E., Scapolo, F., (1999). Technology Map, Futures Report Series 11, EUR19031EN, http://futures.jrc.es/menupageb.htm

Chui, M., Loffler, M., and Roberts, R., McKinsey, (2010). The Internet of Things, McKinsey Quarterly, N.2, 2010

Codagnone, C., (2011 forthcoming). Reconstructing the Whole: Present and Future of Personal Health Systems. Luxembourg: Publication Office of the European Union.

Codagnone, C., and Osimo, D., (2010). e-Government Beyond i-2010: European e-Government current challenges & future scenarios, in Nixon., P., Koutrakou, V., & Rawal, R. (Eds), 'Understanding e-Government in Europe: Issues and Challenges', Routledge Publisher.

College of Europe, Government of the Future Centre, (2010). Building a Better Future in an Age of Transformation, Student Case Studies: Final Report.

Compañó, R., Pascu, C., (2005). Lessons from Foresight on Information Society Technologies, in: Visions on the Future of Information Society, Publishing House of the Romanian Academy, September.

Courtney, H., Kirkland, J., and Viguerie, P. (1997). Strategy under uncertainty, Harvard Business Review, 67–79.

CROSSROAD, (2010a). Deliverable D 1.2, Analysis of the State of the Art of Research in ICT for Governance and Policy Modelling (available at www.crossroad-eu.net).

CROSSROAD, (2010b). Deliverable D.2.2, Visionary Scenarios Design on ICT for Governance and Policy Modelling (available at www.crossroad-eu.net).

Da Costa, O., Boden, M., Punie, Y., Zappacosta, M., (2003). Science and Technology Roadmapping: from Industry to Public Policy, IPTS Report 73, April.

De Laat, B., (2004). Conditions for effectiveness in Roadmapping: a cross-sectional analysis of 80 different exercises, EU-US Scientific Seminar on New Technology Foresight, Forecasting & Assessment Methods, Seville, 13-14 May, http://www.jrc.es/home/foresight_seminar/programme.htm

Dierkes, M.; Hoffmann, U.; Marz, L. (1996). Visions of technology: Social and institutional factors shaping the development of new technologies, Frankfurt am Main, Campus.

Duin, P. van der, Huijboom,, N., (2008). The Futures of EU-Based eGovernment: A Scenario-Based Exploration, Proceedings of the 41st Annual Hawaii International Conference on System Sciences, (HICSS 2008, pp.221).

Eggermont, L., (2003). Interactive Seminar on Science and Technology Roadmapping, European Commission, DG JRC, IPTS.

eEurope Advisory Group (2004). eEurope Advisory Group of leaders of national eGovernment initiatives, Working Paper on eGovernment Beyond 2005 - An overview of policy issues.

European Commission, (2001). eEurope 2002 - An information society for all, COM(2001)140, DG INFSO, Brussels.

European Commission, (2002). eEurope 2005 - An information society for all, COM(2002) 263, DG INFSO, Brussels.

European Commission, (2006a). Riga Ministerial Declaration – eInclusion, European Commission, Brussels.

European Commission, (2006b). Roadmapping eGovernment RTD 2020, Visions and Research Measures towards European Citizenship and Innovative Government, Deliverable D 2.1: Scenarios report.

European Commission, (2007). CIP ICP PSP, Brussels, European Commission, 2002-2006, 6th framework programme, European Commission, Brussels.

European Commission, (2009a). Economic Crisis in Europe: Causes, Consequences and Responses, European Economy 7/2009.

European Commission, (2009b). A knowledge intensive future for Europe, Expert Group Report (October, 2009), EU, European Research Area, Research Policy, Brussels

European Commission (2009c). Consultation on The Future EU 2020 Strategy, Commission Working Deliverable, [COM(2009)647 Final], Brussels, 24 November.

European Commission (2009d). Visions and priorities for eGovernment in Europe: orientations for a post 2010 eGovernment Action Plan, Working Deliverable of the eGovernment Sub-group, 20 March.

European Commission (2009e). Towards the Future Internet: A European Research Perspective, (Edited by Tselentis, G., et al.), IOS Press.

European Commission, DG INFSO, (2004). Action Plan for the implementation of the legal framework for electronic public procurement, European Commission DG INFSO, Brussels.

European Commission, DG-INFSO, (2008a). Report of the Workshop on ICT for Governance and Policy Modelling, Brussels, June.

European Commission, DG-INFSO, (2008b). Study on Future technology needs for future eGovernment Services, (Codagnone, C., and Osimo, D.).

European Commission, DG-INFSO, (2009). Moving the ICT frontiers: a strategy for research on future and emerging technologies in Europe [COM(2009)184 final, 20.04.2009].

European Commission, DG Research, (2009). Research in Socio-economic Sciences and Humanities: Indicative Strategic Research Roadmap 2011-2013, European Commission.

European Commission, (2010a). Europe 2020: A strategy for Smart, Sustainable and Inclusive Growth, Communication from the Commission, Brussels, 03.03.2010, [COM(2010) 2020].

European Commission, (2010b) A Digital Agenda for Europe, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Brussels, 19.05.2010, [COM(2010) 245]

European Commission, ENISA (2010). Online as soon as it happens, ENISA - European Network and Information Security Agency, (February).

European Commission, ISTAG (2001). Scenarios for Ambient Intelligence in 2010, IPTS, JRC.

European Commission, ISTAG (2009). European Challenges and Flagships: 2020 and beyond, Report of the ICT Advisory Group (ISTAG), DG-INFSO.

European Commission, JRC-IPTS, FOREN Network (IPTS, PREST, CMI and SI) (2001). A Practical Guide to Regional Foresight, Seville EUR 20128 EN 121pp available at: http://foren.jrc.es/Docs/eur20128en.pdf

European Commission, JRC-IPTS and European Science and Technology Observatory (ESTO), (2001). Strategic Policy Intelligence: Current Trends, the State of Play and Perspectives - S&T Intelligence for Policy-Making Processes (Edited by: A. Tubke, K. Ducatel, J.P. Gavivan, P. Moncada-Paternó-Castello (EUR 20137 EN).

European Commission, JRC-IPTS, (2003a). Innovation Tomorrow, (LLA, PREST,ANRT) available at http://www.cordis.lu/innovation-policy/studies/gen_study7.htm

European Commission, JRC-IPTS, (2003b). Ubiquitous Computing/Ambient Intelligence: What bends the trend? Technological, foresight and the socialisation of ubiquitous computing, (Edited by Y. Punie) EMTEL II, Deliverable, IPTS: Sevilla, March.

European Commission, JRC-IPTS (2003c). Science and Technology Roadmapping for Policy Intelligence: Lessons for Future Projects, (Authors: Da Costa, O., Boden, M., Friedewald, M.).

European Commission, JRC-IPTS (2004). eGovernment in the EU in the next decade: The vision and key challenges, based on the workshop held in Seville, 4-5 March 2004: 'eGovernment in the EU in 2010: Key policy and research challenges', (Eds. C. Centeno, R. van Bavel, J.C. Burgelman).

European Commission, JRC-IPTS, FISTERA, (2004). Exploring Emerging Applications Report of the FISTERA Trends, Drivers & Challenges Workshop, 16th - 17th June 2004, Seville, Spain.

European Commission, JRC-IPTS (2005). eHealth in 2010: Realising a Knowledge-based Approach to Healthcare in the EU, Challenges for the Ambient Care System, (M. Cabrera, J.C. Burgelman, M. Boden, O. da Costa, and C. Rodríguez).

European Commission, JRC-IPTS (2006a). The Future of the Information Society in Europe: Contributions to the Debate, (Eds. R. Compañó, C. Pascu, A. Bianchi, J.C. Burgelman, S. Barrios, M. Ulbrich, and I. Maghiros).

European Commission, JRC-IPTS (2006b). Towards the eGovernment Vision for the EU in 2010: Research Policy Challenges, (Eds. J. Berce, A. Bianchi, C. Centeno, and D.Osimo).

European Commission, JRC-IPTS (2007). The Future of eGovernment, an exploration of ICT-driven models of eGovernment for the EU in 2020, (Eds. D. Osimo, D. Zinnbauer, A. Bianchi).

European Commission, JRC-IPTS (2008). The Socio-economic Impact of Social Computing, Proceedings of a validation and policy options workshop, IPTS Exploratory Research on the Socio-economic Impact of Social Computing, (Editor Y. Punie).

European Commission, JRC-IPTS (2009a). The impact of Social Computing on the EU Information Society and Economy, (Eds. Y. Punie, W. Lusoli, C. Centeno, G. Misuraca, D. Broster).

European Commission, JRC-IPTS (2009b). Foresight Report – Deliverable 8 of the IPTS Study on Social Computing and its implications for future public services.

European Commission, JRC-IPTS (2009c). Public Services 2.0: the impact of Social Computing on Public Services, (Eds. Y. Punie, G. Misuraca and D.Osimo).

European Commission, JRC-IPTS (2009d). Study on Social Computing and its implications for future public services, TNO, DTI Project n. 150817-2007-FISC-NL, Project Deliverables, (Unpublished).

European Commission, JRC-IPTS, FOR-LEARN (2010). Scenario-Building, Retrieved on April 14th, 2010 from http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_scenario.htm

European Commission, JRC-IPTS, FORERA, (2010). Facing the future: time for the EU to meet global challenges, (M. Boden, C. Cagnin, V. Carabias, K. Haegeman, T. Konnola).

European Union, (2010). Project Europe 2030: Challenges and Opportunities – A report to the European Council by the Reflection Group on the Future of the EU 2030, Brussels, May.

Fast Future Research, (2010). The shape of jobs to come: possible new careers emerging from advances in Science & Technology (2010-2030), Talwar, R., and Hancock, T.

Federal Ministry of Education and Research Germany, (2007). ICT 2020 – Research for innovations, .

Friedewald, M., Da Costa, O., (eds), (2003). AmI@Life – Science and Technology Roadmapping Ambient Intelligence in Everyday Life, Working Deliverable, http://esto.jrc.es/docs/AmIReportFinal.pdf

Frissen, V., (2005). The e-mancipation of the citizen and the future of e-government. Reflections on ICT and citizens' participation. In: M. Khosrow-Pour (ed.) Practicing E-Government: A Global Perspective. Idea Group Inc., Hershey-London-Melbourne-Singapore-Beijing.

Galvin, R. (1998). Science Roadmaps, Science, Vol. 280, p. 803, May 8.

Garcia, M., Bray, O., (2002). Fundamentals of Technology Roadmapping, Sandia National Laboratories, Strategic Business Development Department, http://www.sandia.gov/Roadmap/home.htm

Garfield, B., (2009). The Chaos Scenario, Stieltra Publishing.

Gartner, Industry Research (2005). Government in 2020: Taking the Long View, Andrea Di Maio, Gregg Kreizman, Tichard G. Harris, Bill Rust, Rishi Sood, December 2005.

Gartner, Industry Research (2009). The Future of Government is No Government, Andrea Di Maio, April.

Groenveld, P., (1997). Roadmapping integrates business and technology, Research Technology Management, Vol. 40, No.5, September/October.

Hildebrandt, M., (2009). Behavioural Biometric Profiling and Transparency Enhancing Tools, Project Deliverable, of the Future of Identity in the Information Society – FIDIS, European Commission, www.fidis.net

Janssen, M., Duin, P. van der, Wagenaar, R., Bicking, M., Wimmer, M. (2007). Scenario building for e-government in 2020, ACM Proceedings of the 8th annual international conference on Digital government research: bridging disciplines & domains, pp 296 – 297.

Jaokar, A., and Gatti, A., (2009). Understanding the Impact of Open Mobile: Implications for Telecoms/Devices, Web, Social Networks, Media and Personal Privacy, Futuretext Limited.

Kerr, I., Mann, S. (2006). Exploring Equiveillance. Retrieved on April 14th, 2010 from: http://www.anonequity.org/weblog/archives/2006/01/exploring_equiv_1.php

Kostoff, R.N., Schaller, R.R., (2001). Science and Technology Roadmaps, IEEE Transactions on Engineering Management, 48:2. 132143, May.

Kubicek, H., Westholm, H., (2005). Scenarios for future use of e-democracy tools in Europe, International Journal of Electronic Government Research.

Medaglia, C., Chicca, B., and Orlando, L., (a cura di), (2010). Internet of Things: il 3.0 della P.A. in Rivista 'eGov', N.2. 2010, Maggioli Editore.

Miles, I., (2003). 'Scenario Planning' pp 69-98 in Foresight Methodologies - Training Module 2 Vienna, UNIDO V.03-87775 available online at: http://www.unido.org/file-storage/download/?file%5fid=16957

Ministry of Internal Affairs, Government of Australia, (2005). Governing and Politics in 2025, Research Paper for Business Council of Australia, Scenario Planning Project, 'Aspire Australia 2025'.

Misuraca, G., (2009a). e-Government 2015: exploring m-Government scenarios, between ICT-driven experiments and citizen-centric implications, in Technological Analysis & Strategic Management, Vol.21, N.3, April.

Misuraca, G., (2009b). Futuring e-Government: governance and policy implication for building an ICT-enabled knowledge society for all, in Proceedings of the International Conference on Theory and Practice of e-Governance, ICEGOV2009, Bogotá, Colombia 11-13 November.

Misuraca, G., Broster, D., and Centeno, C., (2010), Envisioning Digital Europe 2030: Scenario design on ICT for governance and policy modelling, in Proceedings of the 4th International Conference on Theory and Practice of Electronic Governance (ICEGOV2010), Beijing, China, 25-28 October 2010 - ACM International Conference Proceedings Series, ACM Press (pp. 347-356)

OECD, (2005). Public Sector Modernisation: The Way Forward, OECD Publications.

Patrick, D., Margetts, H., Bastow, S., Tinkler, J. (2006). New Public Management is Dead-Long live Digital-era Governance. Journal of Public Administration Research and Theory 16: 467-494.

Pew Internet, (2010a). The Future of the Internet, Pew Research Center Series.

Pew Internet, (2010b). The Impact of the Internet on Institutions in the Future, Pew Research Center Series.

Picci, L., (2011 forthcoming). Reputation-based Governance. Stanford, CA: Stanford University Press

Popper, R., (2008). Foresight Methodology. In The handbook of technology foresight, (Eds Georghiou, L, Cassingena, J., Keenan, M., Miles, I., Popper, R), Edward Elgar Publishing.

Punie, Y., (2003). Ubiquitous Computing/Ambient Intelligence: What bends the trend? Technological foresight and the socialisation of ubiquitous computing, EMTEL II Deliverable, IPTS: Sevilla.

Rethemeyer, Karl R., (2006). Policymaking in the age of Internet: Is the Internet tending to make policy networks more or less inclusive? Journal of Public Administration Research and Theory 17: 259-284.

Rethemeyer, Karl R., (2007). The empires strikes back: Is the Internet corporatizing rather than democratizing policy processes? Public Administration Review March/April: 199-215.

Reutter, W., (2005). 2020 – Living in a networked world individually and securely, IFOK, Fraunhofer, IZT, VDI/VDE-IT, Pixelpark.

Rossel, P., Glassey, O., and Misuraca, G., (2009). Report of the COSTA22 Project, Exploring new ways to explore the future, Swiss component: The Shape of things to come in the ICTs sector: trends, shifts and diversity (unpublished).

SIGMA SCAN, (2010) UK Government foresight, available at: http://www.sigmascan.org/

Slot, M., (2007). Future users: An exploration of future user roles in online media and entertainment services; four scenarios. B@Home project WP2, Deliverable2.18, Freeband.

South West Regional Development Agency, South West Regional Assembly, Centre for Future Studies, (2004). South West Scenarios 2026.

Tapscott, D. and Williams, A., (2006). Wikinomics: How mass collaboration changes everything, Atlantic Books Publisher.

The Challenge Network, (2009). Scenarios 2040, draft discussion deliverables available at: http://www.chforum.org/scenario2009/scenarios.shtml

Thomas, T., Cook, K., (2005). Illuminating the Path: Research and Development Agenda for Visual Analytics, IEEE-Press.

Vinnova, (2009). eGovernment of Tomorrow: Future Scenarios for 2020 (Nordfors, L., Ericson, B., Lindell, H., and Lapidus, J.), Gullers Group.

Williams, A., (2010). Wikinomics and the Era of Openness: European Innovation at a Crossroads, Lisbon Council, e-brief (Issue 05/2010).

Williams, P., (2005). Lessons from the future: ICT scenarios and the education of teachers, Journal of Education for Teaching, Volume 31, No 4, pp 319-330, November.

Willyard, Ch., McClees, Ch., (1987). Motorola's Technology Roadmapping Process, Research Technology Management Magazine, Sep/Oct.

Wright, D., (2005). The dark side of ambient intelligence. In Info, Volume 7(6,) pp. 33-51.

Zittrain, J., (2008). The Future of the Internet-And How to Stop It, Caravan Books.

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Abstract

The report *Envisioning Digital Europe 2030* is the result of research conducted by the Information Society Unit of IPTS as part of the CROSSROAD Project – A Participative Roadmap on ICT research on Electronic Governance and Policy Modelling (www.crossroad-eu.net).

After outlining the purpose and scope of the report and the methodological approach followed, the report presents the results of a systematic analysis of societal, policy and research trends in the governance and policy modelling domain in Europe. These analyses are considered central for understanding and roadmapping future research on ICT for governance and policy modelling.

The study further illustrates the scenario design framework, analysing current and future challenges in ICT for governance and policy modelling, and identifying the key impact dimensions to be considered. It then presents the scenarios developed at the horizon 2030, including the illustrative storyboards representative of each scenario and the prospective opportunities and risks identified for each of them. The scenarios developed are internally consistent views of what the European governance and policy making system could have become by 2030 and of what the resulting implications for citizens, business and public services would be.

Finally, the report draws conclusions and presents the proposed shared vision for Digital Europe 2030, offering also a summary of the main elements to be considered as an input for the future development of the research roadmap on ICT for governance and policy modelling.

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