Book of abstracts

FTA
Future–Oriented
Technology
Analysis

The 4th International Seville Conference on Future-Oriented Technology Analysis (FTA)

FTA and Grand Societal Challenges:
Shaping and Driving Structural and Systemic Transformations

Institute for Prospective
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THE 4th INTERNATIONAL SEVILLE CONFERENCE

ON FUTURE-ORIENTED TECHNOLOGY

ANALYSIS (FTA) AND GRAND SOCIETAL CHALLENGES

Shaping and Driving Structural and Systemic Transformations

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The mission of the JRC-IPTS is to provide customer-driven support to the EU policy-making process by developing science-based responses to policy challenges that have both a socio-economic as well as a scientific/technological dimension.

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Useful links

Website of the 4th International Seville Conference on Future-Oriented Technology Analysis (FTA)

http://foresight.jrc.ec.europa.eu/fta_2011/intro.html

Website of the JRC-IPTS European Foresight Action:

http://foresight.jrc.ec.europa.eu/index.html

Website of the FOR-LEARN On-Line Foresight Guide:

http://forlearn.jrc.ec.europa.eu/index.htm

Website of the Institute for Prospective Technological Studies (IPTS):

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Preface

Future-Oriented Technology Analysis (FTA) provides a common umbrella for the foresight, forecasting and technology assessment communities. These closely related communities play an important role in guiding policy and decision making to anticipate and shape future developments. The "International Seville FTA Conference" is a unique occasion for them to meet and to mutually enrich their approaches.

Building on the success of the 2004, 2006 and 2008 events, this fourth edition of the Conference will enable FTA experts, practitioners, and policy and decision makers to share their ideas and knowledge in order to make FTA more policy relevant. The focus, this year, is on how FTA can help shape and drive the structural and systemic transformations that are needed to address grand societal challenges. The programme embraces both methodological aspects and issues in the application of FTA to a range of policy and business fields, including innovation, sustainability, health and energy (to name just a few).

The growing importance of FTA and of the Seville FTA Conference is reflected in the level of interest in this fourth edition. More than 200 participants from all continents are expected to attend the Conference. A total of 188 abstracts have been submitted (an increase of 22 from 2008) and the Conference Scientific Committee has selected 70 papers (14 more than in 2008) to construct a comprehensive programme. The selection process was not an easy one. Several excellent contributions could not, for logistical reasons be presented as papers. However, many of these have been delivered as posters and in the concise and accessible "brief" format.

The proceedings of the Conference are available online as well as in the USB stick distributed to all registered conference participants. In addition, many of the best contributions will be published in special issues of academic journals, as was the case for the previous editions of the event.

The Conference is organised by the *ERA Policy Mixes, Joint Programming and Foresight* Action of the "Knowledge for Growth" unit of the Institute for Prospective Technological Studies (IPTS), an institute of the European Commission's Joint Research Centre (JRC). IPTS is known as a European reference centre on foresight

and is an established contributor to the structuring and enhancement of European foresight capabilities. The *ERA Policy Mixes, Joint Programming and Foresight* Action currently contributes with its foresight expertise to the identification of future Research and Innovation priorities, to the formulation of framework conditions for Joint Programming and to further advancing and disseminating qualitative and quantitative methodologies and application of foresight in the EU.

The conference provides an opportunity to strengthen cooperation within the FTA community and enhance its policy impact. In line with its main mission, IPTS intends to apply both the scientific and practical outcomes of the Conference to its policy support activities and translate them whenever possible into options for policy and decision making. We hope you enjoy the event and we encourage you to participate actively in all the discussions.

Mark Boden
ERA Policy Mixes, Joint Programming and Foresight Action Leader

HOW TO USE THIS BOOK OF ABSTRACTS

You can use this Book of Abstracts as a guide during the Conference.

It includes the extended abstracts of the papers that will be presented during the FTA Conference. The abstracts are organised by theme and follow the structure of the programme.

All Conference documents (including abstract, papers, posters and briefs) are also available on the pen-drive you received with your Conference bag and are available on the Conference website (http://foresight.jrc.ec.europa.eu/fta_2011/intro.html).

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THEME 1

ORIENTING INNOVATION SYSTEMS TOWARDS GLOBAL CHALLENGES

Different types of innovation will need to play significant roles in addressing major global challenges. Yet, the direction of innovation and its implications are often highly uncertain while innovation itself is likely to lead to a great deal of disruption to societies and economies over the coming decades, for better and for worse.

The orientation of innovation systems – in terms of the problems they address, the actors and linkages they include, and the manner of their governance – will largely determine the part innovation plays in responding to global challenges and the extent to which it becomes itself a source of disruptive transformation. In particular, the orientation and coordination of business innovation, public research and higher education are crucial in shaping innovation developments and have been a traditional focus of public policy intervention, including the use of FTA.

FTA can play a number of important roles in orienting innovation systems so that these can better address global challenges. For example, FTA can generate insights that enable a better understanding of global challenges and the means to deal with them through innovation and policy intervention. It can do this by bringing longer-term perspectives and broader knowledge bases into decision-making processes.

FTA can also assist in managing the uncertainty associated with innovation activities and with the future more broadly. It can do this by providing spaces for both businesses and societies to come together to better appreciate their mutual positions vis-à-vis future innovation directions, as well as to build trust and to develop innovation partnerships. This coordination potential extends to policy arenas, where FTA can enhance communication and understanding between policy 'silos' and thereby support the emergence of an effective policy mix for innovation.

Finally, FTA can support organisational and societal agility through anticipation of developmental routes and their consequences, and/or the articulation of widely shared visions that steer evolutions along desirable pathways.

Accordingly, the **aim of this conference theme** is to explore the roles FTA plays in supporting and directing innovation efforts that manage and/or promote major structural challenges affecting contemporary and future societies and economies. Against this background, papers and posters are invited that specifically address, but are not limited to, the role of FTA in:

- Framing the major structural challenges facing contemporary and future societies and economies, particularly with regards to bringing in longer-term perspectives that incorporate broader knowledge bases;

- Generating insights and understanding on these challenges and the means in which they could be dealt with through various forms of innovation and other interventions;

- Better managing uncertainties associated with innovation, both by businesses and societies as a whole;

- Developing organisational and societal agility and resilience that can accommodate and foster radical change as knowledge, ideas, interests and needs from different sources combine;

- Providing discursive spaces and platforms for a variety of actors, including citizens, to come together to better appreciate their mutual positioning as well as to build trust and partnerships vis-à-vis future innovation developments and to deliberate various scenarios of the future;

- Steering innovation efforts that integrate education, business, research and other stakeholders, for example, through processes of prioritisation and advocacy coalition-building;

- Improving the coherence of policies addressing innovation, identifying the levers for improving the dynamics of the innovation system and strengthening its actors to enable structural transformations in contrast to 'silo' approaches, and outlining realistic approaches in mixing supply and demand side policies;

- Enhancing policy coherence between different levels of governance in support of innovation.

The anchor paper on this theme is prepared by:

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IDENTIFYING THE DIRECTION AND PROMOTING FACTORS OF INNOVATION TOWARD GRAND CHALLENGES

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Keywords: foresight, innovation, challenges.

Introduction

The world faces many complex problems like climate change and economic imbalance, and each country has also country-specific problems like rapid aging of the population in Japan. Technological and social innovations are expected to cope with these difficulties and achieve a desirable future.

Foresight in Japan has changed its purposes and roles against the above-mentioned background. Its main role was to identify key technologies or emerging technologies, looking into the development of science, technology and society. But today it aims to discuss innovations that have potential to change our society. Strong emphasis is put on how key technologies or emerging technologies should be integrated and adequately embedded in society to achieve social goals or tackle social issues. FTA is expected to give a framework for integrated knowledge.

Methodology

National Institute of Science and Technology Policy in Japan conducted the ninth foresight exercise in 2008-2010. The basic principle is to discuss science, technology and societal environment that have the potential to change our society toward a desirable future.

The exercise started with the discussion on social objectives and their relation to science and technology, considering changes on a global scale. Based on the discussion, four grand challenges were set as goals of science, technology and innovation policy. Surveys by Delphi, scenario writing and workshops techniques were carried out to articulate a framework for successful innovation.

The procedure is characterized from two aspects: interdisciplinary or diversified discussion and mission-oriented approach. Main points are; Delphi panels by cross-disciplinary theme, not technological discipline; active participation of specialists in social science and humanities;

discussion by a variety of participants including younger generation and local residents; and focused discussion rather than comprehensive approach.

Results and policy impact/implications

Results show that "green innovation" and "life innovation" can be key issues for grand challenges, which should be promoted with the improvement of base technologies and infrastructures. ICT, indispensable technology for achieving social goals, is required to be converged with relevant technologies.

System thinking, which includes not only technical systems but also social systems and provision of services, is essential for embedding technologies in real society. The other accompanying factor is management of technology-related issues, i.e. knowledge base, business, risk, globalization, human resources, and so on. These indicate that the closer the relation among science, technology and society will be in the future, the more interdisciplinary involvements will be expected.

Conclusions

The 9th S&T Foresight in Japan was implemented under the principle of contribution to future society. Integrated discussion that values diversity of disciplines can lead to identification of grand challenges where innovation is required.

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CURRENT AND FUTURE STATE OF EUROPEAN UNIVERSITIES. MINI-SCENARIOS FOR INTERNATIONALISATION AND OPENNESS OF EUROPEAN UNIVERSITIES

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Keywords: Universities, internationalisation, openness, mini-scenarios.

Introduction

In the past decade, European universities have been immersed in intensive transformation processes in order to face the new challenges of more distributed nature of research, innovation and knowledge production. As key actors in innovation systems and in the production and dissemination of knowledge, universities are at the heart of the European policy agenda. Universities have a crucial role in meeting the needs of the knowledge society and achieving equity and social justice in Europe, while functioning as a source of European STI competitiveness at the global level. In this context, they are increasingly questioned concerning their fitness for addressing the challenges of fast moving social, technological and business developments.

The 'Europe 2020' strategy has explicitly recognised the central role of universities in allowing Europe to exit from the crisis and to enter into a smarter, greener and more inclusive economy. As key research performers, universities need to actively respond to changes. The Communication 'Delivering on the Modernisation Agenda for Universities: Education, Research and Innovation' (European Commission, 2006) recognised its importance by underlying the need for universities to become innovative and responsive to changes.

There is an increasing demand for universities to become more open and internationally oriented (European Commission, 2010). There is also an increasing market for qualified graduates that are capable to work in a multi-cultural and globalised society. The recruitment of international students is an important indication of globalisation of universities (Cudmore, 2006; Burnett & Huisman, 2010). Open and international universities are expected to be able to compete globally and to be more productive.

To make universities more competitive and sustainable over time, the current paper suggests the use of Foresight methodologies and techniques to increase their awareness of present and upcoming challenges and develop policies and actions within the context of an overall European Higher Education and Research Strategy. The paper aims to better understand the views on

the future state of universities in Europe. Mini-scenarios are constructed to describe European universities in 2025. We also aim to establish a typology of universities based on their present degree of internationalisation and openness. Finally, we would like to analyse the universities' views on the future change according to their present profile with the aim of discussing whether institutional factors and present and future views of universities influence their responses to globalisation.

Methodology

The information of the study comes from a data collection exercise on 200 research-active universities and a survey to university managers (of the same universities) and university researchers. The data collection exercise, done by the "European Observatory of Research-Active Universities", gathers data on institutional variables and covers universities of 33 ERA countries (27 Member States and Croatia, Iceland, Israel, Norway, Switzerland and Turkey). The survey, organised in the frame of the project ´Quality and Leadership for Romanian Higher Education´, collects views of university managers and researcher on the relationship between higher education and the European Research Area, with a clear focus on research. The survey aimed to offer a European perspective of present and future challenges of European universities. It collected the opinions of senior managers (N=144) and research and teaching staff (N=308) at universities across Europe. The issues addressed in this survey include internationalisation and third mission activities of universities.

Mini-scenarios are constructed combining individual scenario proposals with a multi-criteria analysis of issues assessed by the target group. Scenarios are then linked to their probability of occurrence as seen by university managers and to the universities´ current state.

Results and policy implications

The main results of the study include a description of a set of mini-scenarios on the future of European universities in 2025 and a typology of international and open European universities. Finally, we check whether or not international and open European universities have different views on the future.
The policy implications aim to suggest different actions for universities and to contribute to the policy priority setting for the new "Modernisation Agenda for European Universities" with actions suggested by universities (bottom-up approach).

Conclusions

We find that global and international mini-scenarios are the most probable. We find a positive correlation between internationalisation and openness of universities. We expect universities with more international and open profile to see the global mini-scenario as the most probable for European universities in 2025. We further suggest some policy actions for universities derived from managers and researchers opinions.

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ORIENTING INNOVATION TOWARDS GRAND CHALLENGES: A REAL- TIME EXPERIMENT IN THE APPLICATION OF FORESIGHT-ASSISTED PROCESSES

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Keywords: foresight, grand challenges, FTA capacity building.

Introduction

The Australian Government established a National Enabling Technologies Strategy (NETS) in 2010. A major objective of this strategy is "to increase government, industry and the community's understanding of the ways in which applications of enabling technologies may help to address major global and national challenges and to encourage the responsible development and uptake of these technologies." (DIISR, 2010)

Activities under the NETS include the identification of major challenges which the enabling technologies may address, facilitation of projects that demonstrate applications of enabling technologies, and identification of future skill, capability and infrastructure needs.

An Expert (Foresight) Forum for Enabling Technologies has been established to guide and advise on the implementation of the strategy. As Chairman of the Forum, this author, with extensive experience in the design and application of foresight, has launched a number of 'learning exercises' designed to examine the key influences, be they theoretical, methodological, structural, organisational, economic or cultural, in the effective framing and promotion of initiatives to address future major challenges.

Methodology

The issues that have been examined include:

- What are the important factors in framing arguments about addressing potential major challenges that make them more influential with government officials?
- What are the key aspects of structure and content of processes that contribute to effective stakeholder engagement, particularly on the part of industry?
- What is the relative effectiveness of various approaches to steering collaborative innovation targeted on the enabling technologies?

The context for the research underpinning this paper is a series of foresight workshops with a variety of industry sector representatives. These workshops were designed to identify potential major challenges impacting on the sector and the role of enabling technologies in responding to these challenges. During this process, the views of participants from industry and government on the three issues identified above were surveyed and also were the subject of exercises designed to elicit opinions and experience.

In addition, detailed interviews were held with a range of government officials to establish their views about what their expectation of foresight were, and how they could see it contributing to their roles and responsibilities.

Results and policy impact/implications

The results of this analysis reveal that government officials are primarily interested in the extent to which foresight can reduce uncertainty in their decision-making and provide guidance about possible technological developments and their consequences ie to reduce or remove possible surprises. In summary their driving interest is in moving from multiple possible futures to a single probable and preferred future which would be amenable to their analytical skills and procedures.

In contrast, industry representatives were more interested in the extent to which foresight processes could open up to them the possibility of new business and market opportunities. Their driving interest, in contrast to that of government officials, was to increase divergence in order to discover new possible futures, to which they could apply their strategic planning tools to pursue a beneficial outcome.

Conclusions

These findings indicate both the need to tailor foresight processes and messages to the very different audiences of government and business, and the importance of understanding these different perspectives in attempting to facilitate dialogue between stakeholders and in order to address grand challenges effectively.

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IDENTIFYING S&T AND INNOVATION PRIORITIES FOR THE SECTOR OF NATURAL RESOURCES IN RUSSIA

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Keywords: Critical technologies, S&T foresight, innovation priorities, sector of natural resources.

Introduction

Russia possesses one of the greatest stocks of mineral resources, fossil fuels and water in the world. The extensive exploitation of this stock and inefficient management system have led to serious problems: environmental pollution, a need to move extraction to remote oil-fields and ore deposits, inefficient extraction technologies et al. These issues were addressed in a number of nation-wide Foresight exercises accomplished over the last few years [1, 2], including two rounds of identification of national critical technologies (2006 and 2010), national S&T Delphi: 2025 and S&T foresight:2030.

In 2008, the Russian Ministry of Natural Resources initiated a project aimed at the identification of innovation development priorities in the area of natural resources that was focused more on the efficient management practices. Identified priorities indicated main activities within natural resources management system for mid- and long-term perspectives.

Methodology

The general methodology of all these projects implied a broad consultation of various parties concerned and formulation of a consensus opinion based on expert analysis regarding preferential mid- and long-term routes for development of the Russian natural resources. An important issue was to integrate the results obtained into the national innovation strategy.

The innovation priorities were formulated in response to the current challenges faced by the natural resources complex. Within this approach the core problems in natural resources management were identified, as well as the key goals and relevant measures to meet those challenges. The priorities for innovation development were established for major natural resources: mineral and raw materials; water resources; climate; atmosphere air; biodiversity; dangerous natural phenomena, etc. According to the Foresight methodology, various expert and analytical studies were carried out, including desk research, statistical analysis, in-depth interviewing of leading experts; expert surveys and topical panel discussions. Overall, about 150

key experts from different research areas representing leading research and industry centers were engaged in the study. As a result, priorities have been formulated for natural resources sector, as well as for every specific subsector in particular.

Results and policy implication

The projects were strongly interrelated in terms of the methodological approaches and application of results. In the projects framework there were provided the description of the most important S&T trends in the field of natural resources management and environment protection till 2030 and identification of the most promising areas of innovation development in the concerned field. Besides, suggestions on large innovation projects which could have considerable social and economic impact have been formulated.

They enabled to identify prospective technologies and products in the area of natural resources, as well as prospective markets of their application where Russia could gain advantage. The project results were used to develop federal targeted programmes to support the national science, technology and innovation system.

The overall top priority as identified by experts was to formulate a Green-growth "whole-of-government approach". This implies the formulation of policy principles relying on the best international practices of innovation system management which consists of joint participation of different parties in policy-making and policy implementation. General and more than 30 "sector-specific" innovation priorities would be used in the design of strategic and regulatory documents which define the main public policy directions in this field.

Conclusions

Results of these projects can be widely used by different stakeholders. Project findings on identification of innovation development priorities were used for formulating basic strategic documents of the Ministry of Natural Resources (Geology strategy, Water strategy). Scientific community could use results of long-term Russian S&T foresight for analysis of the most demanded R&D areas. Business community could use all these results for development of company strategies and choice of investment projects related to technological modernization.

Besides, direct results of these projects allow setting up a broad expert network, to inform the expert community with basic Foresight principles and to gain substantial methodological and practical Foresight experience for further activities in this area.

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THE CHALLENGE OF GLOBAL FORESIGHT: LESSONS FROM INTERNATIONAL SCENARIOS AND ROADMAPS ON INTELLIGENT AND SUSTAINABLE MANUFACTURING SYSTEMS

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Keywords: Societal Challenges, International Foresight, Intelligent Manufacturing Systems, Scenarios, Roadmaps.

Introduction

It is widely recognised that major societal challenges require coordinated efforts beyond regional and national boundaries to be effective. This lay down an important challenge also for FTA activities to be truly international. This paper addresses FTA and in particular foresight design and management in the context of international agenda setting activities.

Geographical dispersion, organisational and cultural differences, and numerous participants, for example, bring in novel aspects in foresight design and management on top of lessons learned from earlier exercises around the world. Towards this end, we examine the available literature on international foresight management and conceptualise design and managerial issues particularly relevant in the international context. For instance, scalability of activities is a precondition for ensuring wide and balanced participation of different stakeholders in due time. Also responsiveness towards stakeholders' interests and offering equal opportunities for contributing to the exercise are pertinent to meet the diverse expectations. We describe and analyse a recent foresight exercise that we designed and coordinated in the context of international coordination of research, education and innovation on intelligent manufacturing systems (IMS).

Methodology

IMS2020 is an FP7 project funded by the NMP division of the European Commission within the IMS Framework, conducted by an international consortium from Europe, Japan, Korea, Switzerland and the USA. The project engaged participants from these and many other countries.

The main objective was the creation of five research roadmaps towards IMS by the year 2020 and beyond. Each roadmap focused on one of 5 key areas (KATs): sustainable manufacturing; energy efficient manufacturing; key technologies; standardisation; and education. The aim was to identify relevant manufacturing research topics and the supporting actions which are needed to shape the future of intelligent manufacturing through international cooperation in each of these areas. Four scenario snapshots of possible states of the future by 2025 were developed. Based on these the IMS2020 Vision was defined. The final five roadmaps were designed towards such Vision.

We elaborated a modular foresight architecture that allowed engagement of numerous participants in different roles and with different kinds of contributions. Much of the joint work was conducted using online tools including collaborative platforms like wikipedia, online surveys and video/ teleconferences combined with carefully prepared structured interviews and face-to-face meetings. The meetings were dedicated to the crucial phases such as the scenario formulation and the common definition of the vision for the roadmapping work, which created a sufficient basis to continue refinement of the work in dedicated online spaces as well as an open wiki platform.

The background analysis involved both an analysis of i) scientific literature and of ii) the main areas covered by eleven roadmaps coming from Europe, Japan, US, Korea and Canada. In the same line, a more detailed analysis of the variables used to build scenarios/roadmaps and the research topics within the analysed roadmaps were undertaken for all five KATs. The results were the basis for the selection of the variables used to develop the scenarios within the IMS2020 project. Moreover, the online questionnaires and interviews with key actors took into account those research topics already mapped so that new topics could be identified.

Results and policy impact/implications

Both the devised vision and related roadmaps, which include the milestones of innovation activities (research topics, management and policy actions) identified, have been open for wide consultation in the IMS region and beyond.

The roadmaps depart from the implementation of the identified research topics and supporting actions between 2011 and 2013, and show the possible impacts or benefits that these could deliver in a timeline towards the IMS2020 Vision. These were shaped around: (i) research topics which act as 'bricks' with short term implementation needed (starting in 1-3 years and to be concluded in 3-7 years); and (ii) actions that are of mid-term implementation (7-10 years), with a wider focus and linked to the research topics, but equally important in attaining the IMS2020 Vision.

Both the research topics and supporting actions identified for all 5 KATs as well as the expected impacts of their effective implementation have been included in a timeline between 2011 and 2020. Final results have been presented in the form of roadmaps between today and end of FP8 to enable the EU Commission to identify and select research priorities to be funded in collaboration between today and 2020. Results were used to shape further FP7 calls are currently being used in defining FP8.

Conclusions

The IMS2020 scenario and roadmapping process shed light on some challenges in organising international foresight exercises. The scalable design was crucial for adapting to geographical dispersion and numerous participants. Furthermore, the responsiveness to stakeholder needs and interests in course of the exercise was crucial to keep the participants motivated and to share the ownership of the outcomes. Building on this experience, we conclude that the online working tools can offer major support for efficient and participatory management of foresight when their use is integral part of the design of the whole exercise.

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FROM GRAND SOCIETAL CHALLENGES TO POLICIES AND RESEARCH PRIORITIES: SOME DANISH EXPERIENCES.

Per Dannemand Andersen

Keywords: Priority setting, Strategic research, Politics.

Introduction

This paper aims to contribute to the discussion on FTA's role in dealing with such grand challenges and in setting national priorities for strategic research in order to respond to the challenges.

All countries are facing grand challenges of a global scale. Denmark share most of these challenges with comparable European nations, but the country also has been exposed to a few unique longer-term challenges such as decreasing revenues from the North Sea oil and gas recourses and challenges related to values and foreign policy.

Denmark has a strong tradition for consensus based policy making and a weak tradition of policy making based on systematic analyses of existing knowledge (Togeby et al. 2003). At the same time planning culture in Denmark is characterized by a low level of uncertainty avoidance and low power distance (Hofstede, 1984). Together, this creates what has been characterised as a specific "style" for dealing with foresight and grand challenges (Keenan and Popper, 2008)

In the spring of 2005, the Danish Government launched a process, the Globalisation Council process, to prepare and present a vision and a strategy for the development of Denmark to become a leading growth, knowledge and entrepreneurial society. The process led to a comprehensive strategy titled: Progress, Innovation and Cohesion Strategy for Denmark in the Global Economy. The strategy contained 350 detailed initiatives, which together would lead to comprehensive reforms of policies on education, training, research and entrepreneurship, as well as changes in the general framework conditions for growth and innovation. A major part of this strategy has subsequently been translated into legislation. Concerning FTA methods the process of the Globalisation Council included both expertise oriented elements (expert panels, expert discussion papers), evidence oriented elements (indicators and fact reports) as well as interaction oriented elements (conferences, workshops, stakeholder inclusion, citizen inclusions).

One of the elements of Globalisation strategy was initiatives to improve the basis for the political priorities of the funding for strategic research. The Government (and the Parliament) aimed at a catalogue of themes for future strategic research to meet the society's long-term challenges — both threats opportunities. This was the background for Research2015 process. The Research2015 process included elements such as horizon scanning, expert panels, user panels,

dialogue meetings, conferences and workshops (VTU, 2008). A catalogue of 21 themes formed the basis for the budget negotiations for the Fiscal Act for 2009 and 2010, where 11 for the themes were allocated funding for strategic research. Sustainability oriented research such as energy, environment, climate, climate adaption and sustainable transport & infrastructure accounts for 76% of the implemented priorities. Contrary to many other national foresight and science priority-setting exercises the Research2015 process was exposed to a thorough evaluation (VTU 2009). Measured by the success criteria of this evaluation the Research2015 is generally considered as a successful exercise. This success might be due to the fa This might be due and by success criteria suggested in foresight literature (Calof and Smith, 2010), Tje

Methodology

The paper is based on publicly available documents on 1) the governmental Danish science, technology and innovation system, 2) the Government's Globalisation council process, and finally 3) the Research2015 process of priority setting of the strategic research.

Conclusions

The paper concludes on the results and impact of the Research2015 process and discusses the role of FTA methods in analysing grand societal challenges and in generating priorities for strategic research. Furthermore the paper discusses how political traditions and national preconditions affect the success of using FTA in such processes.

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ORIENTING INTERNATIONAL SCIENCE COOPERATION TO MEET GLOBAL 'GRAND CHALLENGES'

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Keywords: Research foresight, international science cooperation, scenarios.

Introduction

Over the coming decades, science will play a key role in society's response to emergent global 'grand challenges' such as resource scarcity and global environmental change. Science itself will also be a source of new challenges and opportunities through its contribution to technological change in areas such as the transition to a sustainable society, health and lifestyles, agri-food or the development of new defence tools. The agenda-setting, coordination and conduct of science, and the ways in which scientific knowledge is diffused and used, are therefore critical issues. Increasingly, such issues need to be framed at the global level, reflecting both the international nature of science itself and the scale of the challenges it seeks to address. Longer-term perspectives must also be incorporated to reflect the time horizons of key global challenges and the uncertainties involved in future global governance regimes. Foresight offers a means to explore these international, long-term dimensions of science and the internal and external factors that drive its evolution.

The International Council for Science (ICSU), which promotes international science for the benefit of society, is applying foresight as a central component of its strategic planning. Founded in 1931, ICSU has a global multi-disciplinary membership composed of professional scientific societies and national academies of science. It leads the international science community in planning and implementing new trans-national and interdisciplinary science programmes, and communicates science to global policy-makers.

Methodology

ICSU's ongoing foresight exercise seeks to explore how two decades from now international collaboration in science might foster progress in science and benefit society, as well as to identify the key drivers influencing science in the next twenty years. It does not address the mapping of

future research priorities, since many organizations, national and international, are doing this already. A scenario approach is being used to define four world views differing in economic, social, political, and environmental context and with different positions and roles of science. These worlds lead to different challenges and consequences for international collaboration in science.

Results and policy impact/implications

Using this, ICSU as an organization wishes to test its role and mission and to guide its long-term strategic choices. The process engages ICSU's global network of members, bodies, partners, and stakeholders through consultations designed to build mutual understanding of ICSU's current role and to solicit viewpoints and, ultimately, buy-in on the organization's future direction. The collection and analysis of potential key drivers and creation of exploratory scenarios is designed also to help ICSU Members and other interested parties develop their own strategic thinking.

This paper describes ICSU's foresight process and highlights the challenges associated with conducting such exercises in international arenas. The paper reports on the results of the exercise, especially the key drivers of change and the resultant exploratory scenarios. These scenarios provide important insights on a variety of organizational options for international science and the roles science (which includes the social and human sciences) could play in addressing future global grand challenges.

Fraunhofer Future Markets: From Global Challenges to Dedicated, Technological, Collaborative Research Projects

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Keywords: Fraunhofer Future Markets, Global Challenges, FTA in contract research, distributed contract research organisation.

Introduction

The mission of Fraunhofer as Europe's largest contract research organisation is to conduct innovation-oriented research for the benefit of private and public enterprises as well as society in general. As a decentralised organisation, Fraunhofer's strategic R&D-portfolio planning takes predominantly place at the level of its 60 institutes. They plan their core competencies and business segments quite self-determined based on market demands and their position in the scientific community. At a corporate level, Fraunhofer complements these strategic planning activities with a process to identify and strategically develop research themes across institutes (Fraunhofer Future Topics). Fraunhofer performs this process iteratively every three years (see also Klingner et al. 2008).

Fraunhofer's R&D fields are traditionally technology-driven and based on technological competencies. To foster needs-oriented thinking within the organisation, Fraunhofer adapted its corporate Future Topics process. In 2010 Fraunhofer initiated a Program called *Future Markets*, in which grand societal challenges serve as a basis for identifying research themes across Fraunhofer institutes. After the identification of the strategic themes the program aims to fill every theme with the most promising interdisciplinary research project within Fraunhofer. Distributed competencies within the Fraunhofer Institutes will be focused towards the themes and aligned synergistically. This action-oriented foresight process will identify and promote promising technologies to solve urging societal challenges and open up new markets for Fraunhofer R&D-services.

Methodology

In 2010, the starting point of the process is a set of global challenges as defined in the UN Millennium Project (Glenn et al. 2009). Fraunhofer analysed, re-structured and selected the challenges

according to potential Fraunhofer contributions and market potential. Subsequently, five challenges were formulated to serve as a frame for the new Fraunhofer *Future Markets* program:

- *Energy:* Low-loss generation, distribution, and utilization of electrical energy
- *Healthcare* - Affordable Health
- *Environment* - Life cycle production
- *Mobility* - Reliable, low-emission mobility in urban areas
- *Security* - Detection and handling of disasters

Within the program, the institutes are called upon to form consortia and develop interdisciplinary research projects to tackle these challenges. As an incentive to participate in the competitive call, the most convincing projects are internally funded with a relatively large budget in the Fraunhofer context. Collaboration within the Fraunhofer innovation system and an interdisciplinary problem-solving approach are fostered since project consortia have to consist of at least 4 institutes, preferably with diverging technological competences. The evaluation criteria for the project proposals have a strong emphasis on the anticipated impact on the challenge rather than the scientific depth of the technological approach.

Results and policy impact/implications

More than 130 research teams within Fraunhofer participated in the call. They contributed to 25 interdisciplinary project ideas. 20 of them led to full project proposals. In a first evaluation round a jury consisting of Fraunhofer-external and -internal experts chose five of the projects to be funded. The research projects start in April 2011 with a duration of three years.

Conclusions

Using global societal challenges as a starting point Fraunhofer initiated a program to establish new markets for its R&D-services. We identified three key lessons for Fraunhofer

- Combining top-down elements (defining suitable challenges at the corporate level) and bottom-up elements (proposing project ideas at the institute level) is a well suited action-oriented FTA approach for the multi-stakeholder environment of Fraunhofer.

- The program started a learning process within the organisation. However, needs-oriented thinking requires a real mindset change of the technology-driven Fraunhofer scientists.

- Quantifying the anticipated benefit of the research project with respect to the societal challenge is the toughest part. The impact analysis needs to be designed carefully. External experts with market-knowledge are a critical success factor to evaluate the impacts of the projects.

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EXPLORING THE USE OF FUTURES RESEARCH IN INNOVATION SYSTEMS

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Keywords: Innovation systems, innovation, futures research, cases, ICT, water management.

Introduction

There is a shift towards an 'open' approach in both futures research (Daheim and Uerz, 2008) and innovation management (Chesbrough, 2003) in which organisations increasingly share, exchange, and develop knowledge with the outside world. This approach differs significantly from the 'closed' approach with far-reaching consequences for organisations that attempt to be innovative and forward looking. For instance, intellectual property should not be kept in-house but actively be exchanged as no single company possesses all the knowledge required for developing an innovation (Chesbrough, 2003). Also, the future is increasingly considered a source for 'action and innovation' (Daheim and Uerz, 2008, p.330) instead of a source of uncertainty and risk.

The relationship between innovation and futures research has been studied often (e.g., Van der Duin, 2006; Rohrbeck and Gemünden, 2009; Von der Gracht et al., 2010). However, these studies focus on the relationship within a company. What the relationship is between 'open futures research' and 'open innovation' has not been the topic of many studies yet.

In this paper we want to contribute to research on this topic by exploring what the impact is of 'open innovation' on the execution of futures research. More specifically, we investigate the use of futures research (i.e., its organization, processes, and methods) in innovation systems (IS) in three case studies by applying the Cyclic Innovation Model (Berkhout et al., 2006).

Methodology

The Cyclic Innovation Model emphasizes strong and balanced linkages between the image of the future (visualizing the future of the IS), the innovation processmodel (used to guide the execution of the innovation processes of the IS), and the transition path (illustrating to what extent the visualized future is realized). 'Open leadership', at the center of the framework, is

responsible for facilitating the linkages between these three elements and providing linkages with other ISs. We will use this model to describe and analyze different cases on the linkage between futures research and innovation systems.

Results

Case 1: EIT ICT Labs

The European Institute of Innovation and Technology (EIT) was founded by the European Commission (EC) to overcome the 'European innovation paradox'. The EIT ICT Labs aims to foster innovation in ICT, provide an innovation framework consisting of instruments integrating the "knowledge triangle" of education, research, and innovation. 23 core partners and approximately 60 associated partners (innovation system) aim to establish an innovation framework fostering entrepreneurship and innovation in established companies from idea generation to commercialization in a collaborative fashion (process model, transition path). Three guiding principles for the built-up of the EIT ICT Labs are open innovation, future orientation (futures research), and strong and visionary leadership (leadership).

Case 2: Innovation at *Rijkswaterstaat*

Deltas have to cope with increasing pressure on land use and the consequences of rising sea-levels. Usual methods and solutions are no longer satisfactory for subsequent challenges and ambitions of policy makers. Consequently, truly innovative approaches and technologies have to be developed and implemented. Dutch governmental organization Rijkswaterstaat and water management research and consultancy company Deltares have attempted this in the water innovation programme WINN.

Conclusions

Case 1: EIT ICT Labs

In contrast to most other publicly funded research instruments of the EC, the EIT ICT Labs are organized business-style, i.e. it has a clear vision and mission (*vision*), a general assembly consisting of core and associate partners, an executive steering board and a chief executive officer who is head of a 12-headed management team and responsible for the application of the vision via strategy down to the day-to-day operations. Moreover, the EIT ICT Labs are organized as a web of five nodes (for the time being) with so-called co-location centres (CLCs), places to increase collaboration and effectiveness by physical proximity.

Case 2: Innovation at Rijkswaterstaat

An analysis of this innovation programme shows that setting up innovation teams consisting of members of both organisations is working rather well because of complimentary competences, that cooperating with other commercial organisations is difficult because of different opinions on confidentiality, and that innovation processes should not be mixed up with regular projects. Furthermore, based on the type of innovation to be developed (from incremental to radical) radical) different elements of the innovation system and the accompanying vision of the future should be emphasized. If the innovation ambition is

radical, more room should there be given to formalized and top down visions of the future and more 'open' should the innovation system be.

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NANOTECHNOLOGY RESEARCH IN INDIA: CHALLENGES AND FUTURES ANALYSIS

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Keywords: Nanotechnology, Innovation, Foresight, Forecasting, Technology Futures Analysis, Technology Roadmapping, Cluster Approach.

Introduction

The present study has been conducted at the backdrop of a time which is witnessing an ushering of an era, which is hailed as promising and a panacea for many problems of a present day society. Given such an illustrated introduction of nanotechnology by various sources, the interest and motivation to carry out a research work on its matter was quite obvious. For a better understanding of the rationale behind the present study, it is important to know what nanotechnology is, why is it different from previous technologies, its disruptive nature, its benefits and applications, its role in developing countries like India (or transforming country, a term recently used by World Bank, for India), and then why it is imperative to focus on R&D aspects from a altogether different perspective now. As far as India is concerned, the Government of India through its Department of Science and Technology (DST) is playing a major role in nanotechnology research in the country. It's the nodal agency for sanctioning nanotechnology projects and allotting funds. There are hundreds of such projects being undertaken in various universities, research centres and through public-private partnership, all over the country. This paper tries to apply technology foresight approach in to the nanotechnology R&D and come up with some valuable outcomes for policy and decision makers. Nanotech and Global Challenges

Methodology

The study is based on both quantitative as well as qualitative data. For primary source of data, field survey of some universities, research centres and industries were undertaken. The selected scientists/professors/experts working in nanotechnology research projects were interviewed and their insights were drawn into this study. For secondary source of information regarding nanotechnology and its research, many reports, journals, articles, books and Internet were consulted. In the case of applicative part of the research work, an attempt is made to use a foresight methodology i.e. Technology Futures Analysis for nanotechnology research. This

methodology is the latest form in the evolution of future studies, claimed to be much better and comprehensive than the various forecasting or foresight techniques. As part of its application in the present study, a combined Technology Roadmapping and Cluster Approach are used.

Results and policy impact/implications

At policy-making front, Technology Futures Analysis(TFA) makes it possible to see which components of the cluster should be added, and in which time frame. Policy makers may accordingly seek to establish new institutes. It also helps them in preparing a cluster for the future by adding institutes and other components. TFA as a foresight methodology will help in channelizing the available expertise and funds in a more better way to accomplish maximum benefits.For research organizations it is important tom learn where research is needed and where it is not. The roadmap informs them what the companies already know, where companies experience problems and where these companies can provide an answer.It can also help them raise interest and funds. This makes the basic research more applied, without losing the longer-term benefits of fundamental research.At company level, the roadmapping process helps in identifying with which companies one should cooperate and what the goals could be. Furthermore, the roadmap can help to distribute the efforts of companies. Without the roadmap, it is possible that all the players aim for the same market, although there are more markets available.

Conclusions

The significance of the present study is that it made an attempt to analyze a sector which is emerging and has also an element of disruptiveness. The idea which is generated is that when it is imperative to venture into an area which has high uncertainty quotient and thus is very cost-intensive, resource-intensive and time-intensive, it is always beneficial if there is a kind of foresight study being done in advance. This is precisely, this research work tries to explore for nanotechnology research in India. It was seen that with TFA the R&D efforts could be better channelized and a 'synergetic-effect' could be generated.

NBIC, GRAIN, BANG, AND TECHFARM™: ADVANCED SCIENCES CONVERGENCE FOR SURVEILLANCE OF EMERGING SCIENCE & TECHNOLOGY TRENDS

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Keywords: TechFARM, GRAIN, BANG, ADAMS, NESTS, nanotechnology.

Introduction

Strategic decision-making requires a knowledge base, analytical capability, foresight, risk-assessment, and optimization. The process of Advanced Sciences Convergence is to understand how advances in different disciplines, and focusing on discrete problems and applications, can coalesce to solve a seemingly intractable problem. Recent advances in both science and technology have provided the means to study, understand, control, and even manipulate transitional characteristics between isolated atoms and molecules, and bulk materials. Various "designer" materials capable of producing devices and systems with remarkable and desired properties have recently been fabricated. Such innovations have occurred in multi-disciplinary environments. Such advances in conjunction with advances in biotechnology, information technology, cognitive sciences, genetics, and artificial intelligence are employed to develop futures-oriented analytical methodologies by further including heuristics, data-mining, scientometrics, modelling and simulation, and scenario development to provide systematic recognition and evaluation of new or existing scientific and technologic (S&T) solutions and their potential for integrated, novel and/or unconventional approaches to 21st century challenges.

Methodology

The synergy arising from the convergence of nanotechnology, biotechnology, information processing and cognitive sciences (NBIC) offers great potential for transformational and revolutionary opportunities with many technological applications. To explore this realm, a methodology termed "Technology Foresight, Assessment, and Road-Mapping" (TechFARM) – a multi dimensional futures-oriented modality that identifies and manages emerging and/or disruptive science and technology trends is articulated. In literature similar initiatives termed as GRAIN and BANG appear with similarity to NBIC – however TechFARM is comprehensive and an exhaustive method and will be described in detail in conjunction with the latest tools such

as, automated data analysis, mining and surveillance (ADAMS) and new and emerging science and technology surveillance (NESTS) are likely to provide a unique framework of the future capabilities that are scientifically feasible, recognized and cross-validated.

Results and policy impact/implications

The methodology and results presented here will immense policy implications in defense, safety, and security. The basic premise of the methodology is to provide a vision into future by scientific and cross-validated models. Such vision will allow policy makers to take action which are strategic, timely, and less expensive than consequence management,

Conclusions

Through "framework by design", an ASC strategy is posited and modelled that will focus science convergences methodologies to describe how far-reaching, visionary- yet achievable albeit undefined outcomes may be achieved and analyze high-yield and high-risk research into futuristic devices and systems to solve great challenges in environment, defense, and security.

SCOUTING THE SOCIO-TECHNICAL LANDSCAPE FOR POTENTIAL NANOTECHNOLOGY TRIGGERED AGRIFOOD SECTORAL TRANSFORMATIONS

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Keywords: agrifood, nanotechnology, co-evolution, transformations, socio-technical.

Introduction

New and emerging science and technologies (NESTs), such as proteomics, bioelectronics or nanotechnologies, may impact many sectors with a variety of industrial structures. For those wishing to enable beneficial technology applications stemming from potentially breakthrough areas of science and technology, such as nanotechnology, this complexity increases as we shift from retro- to prospective analysis of potential paths to innovation and the journeys that will be taken from idea to technical application well embedded in society.

In the field of nanotechnology these challenges are further compounded due to the early stage of nano developments, where promises proliferate around the benefits and risks that may become reality as nanotechnology matures. It is uncertain what sort of sectors will be impacted (or created) by nanotechnology innovations and how the regulatory, economic and societal landscapes will co-evolve.

Therefore, those wishing to develop strategies for managing nanotechnology emergence not only face the general challenge of prospecting possible pathways for innovation they also are challenged to prospect the changing environments and framing conditions that will determine whether an innovation will move from a hopeful proof-of-principle to a product well embedded in our society.

One of today's key grand challenges is the transformation of the agrifood system into a sustainable food production and distribution system, with less waste (from production and packaging) and one that provides the right nutrients in the right balance. Many national policies are looking towards future technology options in providing biodegradable packaging, antimicrobial materials to prolong shelf-life, fortification of foods with minerals and vitamins etc.

Nanotechnology, and particularly nanobiotechnology, is garnering great interest from funding agencies, however anticipation is abound on the potential risks to health and the environment,

as well as opportunity costs for investing in technological solutions rather than others (such as lifestyle solutions).

For those seeking to augment agrifood sectoral transformations by directing technology investments, future-oriented analyses need to be tailored, not only to project technology trajectories, but to speculate (in a controlled way) how the socio-technical landscape (the various environments and framing conditions that will shape future innovation journeys) will evolve.

Nanotechnology is beginning to enter markets in places such as pesticides, food packaging, fortified and novel foods, quality control in food processing industry and the livestock industry. As nanobiotechnology enters this diverse array of sectors, the emerging governance arrangements of nanotechnology meet incumbent (and still developing) governance regimes, consumer positions and actor arrangements.

The approach, built on the sociology of expectations, (co) evolutionary theories of technical change and techno-economic networks – captures the entanglements of emerging innovation chains in nanotechnology and how they are shaping (and being shaped by) the incumbent socio-technical landscape of the agrifood sector. The paper argues that capturing these entanglements through multiple methods provides intelligence that can be fed into scenario approaches and provide the backdrop to open-ended forms of roadmapping.

Methodology

The paper outlines a means of capturing such data in the form of socio-technical mapping, as strategic intelligence on the landscape in which technological/innovation trajectories are projected. It does so by combining qualitative and quantitative approaches. It presents material gathered qualitatively through document analysis, more than 50 expert surveys, more than 30 interviews and three multi-stakeholder workshops.

Results and policy impact/implications

The paper presents insights into emerging nanotechnology supply chains and the potential co-evolution of nano supply chains, and the agrifood sector. Moreover, the paper presents the beginnings of a more robust approach which those seeking to make policy decisions on technology and agrifood systems. Arguably the approach can be applied elsewhere and to other global challenges.

Conclusions

The coupling of socio-technical landscapes and emerging technological innovations is an essential element of innovation governance and policy. The potential co-evolutions are important to explore, placing high requirements on the FTA practitioner. This paper presents a first round approach based on deep case research and on a real societal challenge. The approach will be further developed to incorporate quantitative analyses.

ARCHETYPAL PLANNING SITUATIONS: AN APPROACH FOR SELECTING FTA TOOLS FOR GLOBAL CHALLENGES

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Keywords: Public sector planning, FTA tools scenario planning, Adaptive Foresight, backcasting, transactional environment, contextual environment, global challenges.

Introduction

In the context of societal long range planning several methodological approaches are applied, e.g. various kinds of forecasting, external explorative scenarios (like the Shell approach) and backcasting. According to Börjeson et al. (2006), the choice between these categories depends on what question about the future you are interested in: What is likely to happen? What can happen? How can a specific target be reached? However, this and other typologies (Bradfield et al. 2005, van Notten et al. 2003) have little to say about the significance of the planning situation that the prospective FTA tool user is facing. Based on our experience of future-oriented work, in this paper we attempt to remedy this situation by developing a rational framework for this type of choice.

Methodology

The starting point for this contribution is the authors' personal experience of future-oriented work, starting with national security in the 1970's and 80's respectively, and then expanding into areas like environment, energy, transport, societal security, as well as research and innovation. This work has been summarised and/or contextualised in publications like Börjeson et al. (2006), Dreborg (1996) and (2004), and Eriksson (2004). Most recently Eriksson and Weber (2008) coined the title Adaptive Foresight for an approach that captures much of our experience. At a craft level, the tradition we feel the greatest affinity with is the Shell school, e.g. van der Heijden (1996). This in spite of the fact that all our work has been based in the public sector, albeit often – and increasingly – with private sector participation. Another important strand for us is backcasting, particularly in the face of major environmental challenges (e.g., Dreborg, 1996).

Arguably the present paper is based on critical self-assessment, on re-analysing critical comments and situations where we found it difficult to communicate with participants in FTA exercises and the like. The framework we propose consists of three main attributes pertaining to the planning entity and the future-oriented problems it is facing. These are (presented with illustrative examples):

- *Mission:* A key aspect here is that public sector organisations, e.g. providers of public security, typically are subject to *an obligation to serve* under all circumstances, whereas a 'normal' private business is free to choose which demands to cater to, or eventually to terminate its business altogether.

- *Production technology:* The key attribute here is *flexibility vs. rigidity*, where extreme flexibility trivially renders future-oriented work irrelevant, whereas different sources of rigidity require different investment strategies.

- *The planning entity in its environment:* Here we study the relative importance in influence terms (for the problem in focus) between the entity itself and its transactional and contextual environment, as well as key qualities of these domains.

Conclusions: Results and policy impact/implications

We found this framework helpful in understanding the usefulness of alternative FTA tools, both by economically summarising conclusions already well-known to us and by surfacing new insights.

With regard to Global Challenges we are reassured of the usefulness of Adaptive Foresight, but also acknowledge the need for methodological development to better accommodate natural science knowledge on phenomena like threshold and tipping-point effects. Such knowledge is of key importance in particular for climate change policies, and the irreversible nature of the phenomena render them both epistemologically problematic and challenging to the wait-and-see element of Adaptive Foresight.

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LAW AND THE FUTURE. THE ROLE OF FUTURE-ORIENTED TECHNOLOGY ANALYSIS (FTA) IN LAW: THE CASE OF LEGAL RESEARCH, LEGISLATIVE DRAFTING AND LEGAL ENFORCEMENT

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Keywords: Law, Future-Oriented Analysis (FTA), Foresight, Technology, Legal research, Legislative drafting, Law enforcement, Hyper-regulation.

Introduction

Future and Law are two words that are hardly found in the same phrase. Law tends to adapt to the pace of time through a gradual process, refraining from any attempt to anticipate its forthcoming developments. As such, law has a deeply embedded reactive nature. The typical juridical mind works backwards, looking at the past in order to address the present, while forgetting the future. Due to such mindset, lawyers tend to construct a legal world characterized by order and stability, and – thus – resistant to change and transformation. Pursuant to this logic, the legal mind works according to the values and parameters of legal security and certainty, neglecting the use of forecasting techniques and risk assessment procedures. As a result, legal research supporting policy decision-making tends to present a rather restrictive scope, looking solely to the immediate past in order to find the factual evidence justifying its policy recommendations. As a consequence, recent legislative drafted instruments are soon outdated and, as a result, legal enforcement is hardly ever effective.

Methodology

This paper argues that the reactive nature of law as we know it can no longer account for the technological acceleration that is shaping the globalized society of the 21st century. Thereby, the article attempts to sketch a new methodological approach to law, reflecting upon the application of future-oriented analysis (FTA) – as a common umbrella for the foresight, forecasting and technology assessment research techniques – to three specific cases: legal research, legislative drafting and law enforcement.

Regarding the latter, the paper analyses the phenomenon of "predictive policing" used in the US. Such term is employed to define the work of computer scientists in exploring data models that predict and map crime. Such activity enables law enforcers to anticipate and prevent criminal activity, interpreting patterns of data to wisely deploy resources. Concerning legislative drafting, the hypothetical application of legal requirements of future impact assessment

attached to legislative making is presented as an example of a possible FTA activity applied to the legislative drafting process. Accordingly, legislators would need to explain both the future need and the future consequences that a particular piece of legislation would address. Such requirement would thus presuppose the exercise of FTA activities such as technology foresight and assessment. Regarding the case of legal research, the paper analyses the advantages of using 'roadmapping' and 'scenario-construction' as instruments supporting the policy-making process. In this particular, the article examines the ongoing "Law of the Future project" (www. lawofthefuture.org) and its envisaged outcome of producing a "Law Scenarios 2010" document. Still within the field of legal research, but more focussed on the technological front (exploitation of information resources and data mining), the paper also analyses the European project: "FuturICT Knowledge Accelerator" (www.futurict.eu). Aimed at advancing our understanding of human and environmental systems, the project proposes to use real time data (financial transactions, health records, logistics data, carbon dioxide emissions, or knowledge databases such as Wikipedia) in order to construct a model of society capable of simulating what the future holds for us. The paper examines this particular case-study as another example of a FTA technique that can be applied to law.

Results and policy impact/implications

The applications of FTA techniques are presented as potential and viable solutions to one of the major problems affecting contemporary legal systems: the legal hyper-regulation imposed upon society, compounded by the excessive promulgation of legislation. Rather than today's primarily `reactive' work, according to which law responds to observed economic trends and already-occurred societal events, the paper demonstrates that law will need to focus on proactive, future-oriented analysis and techniques.

Conclusions

The paper underlines the roles that FTA can play in managing the uncertainty and addressing the challenges that law needs to cope with in terms of legal research, legislative drafting and law enforcement. In offering a series of specific cases and examples applied to each of these three areas (as a methodology approach), the article argues that the adoption of FTA by law will contribute to diminishing the excessive legislative production permeating society and to a more effective and coherent support to EU policy-making.

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EXPLORING, IMAGINING AND CREATING FUTURE TV EXPERIENCES FOR/BY USERS: A CASE STUDY ON INNOVATION FORESIGHT

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Keywords: Innovation Foresight, TV experiences, stakeholder interaction, participation, innovation development.

Introduction

The literature on innovation and technology foresight increasingly emphasises the interaction between various stakeholders in innovation processes and the need for (systemic) policy instruments to facilitate such interaction (see e.g. Smits & Kuhlmann, 2004). Our focus is on the involvement of current and prospective technology users as key stakeholders, whose needs, expectations and experiences should be systematically taken into account (Haddon et al., 2005). In this paper, we elaborate on the concept of Innovation Foresight (IF) (De Moor & Saritas, 2009) as an interactive, participatory and forward-looking way of 'social shaping of technology'. IF introduces a systemic and inclusive vision development process with long-term perspective based on 1) *information* to understand the complex interactions between products, services, users and other stakeholders in multiple contexts, 2) *imagination* in a holistic innovation ecosystem by integrating foresight, creativity and design, 3) *intelligence* through scanning of novel ideas, unexpected issues, trends, etc. and 4) *interaction* with current/prospective users continuously beginning from the earliest phases of innovation development (Saritas, 2010). Illustrating the idea and principles of IF, the paper zooms in on two empirical studies in which current and future users were closely involved in the exploration, imagination and creation of (future) TV experiences.

Methodology

Study 1 investigated the gap between adoption and use diffusion for digital TV (DTV) in Flanders and aimed to identify users' specific (future) needs concerning digital TV though an online survey

(N= 11.802 digital TV users). In this paper, we focus on the identification of these unfulfilled needs and possible lead user ideas. These ideas were evaluated in terms of market potential, innovativeness and current status by an expert group of 15 Flemish experts on DTV.

Study 2, in which current and prospective users were actively involved, explicitly focused on 'Future TV experiences'. This study was set up in collaboration with the 'Philips Consumer Lifestyle' group (Philips Bruges) and focused on the questions: 'What do the possible, probable and/or preferable 'TV experiences of the future' – combining Internet and TV - look like according to different user types (time horizon: 2030)? A multi-method approach was used to stimulate users' creative and imaginative potential in the IF process. This study consisted of 3 consecutive phases in which several stakeholders were involved. In the environmental scanning phase (*phase 1*), current TV watching patterns, user profiles, trends were explored by scanning literature and trend reports, combined with an expert consultation round (N=10) and a number of user interviews. Drawing on insights yielded through this environmental scanning exercise, so-called positive and negative 'assumption personas' were developed in *phase 2*. Additionally, (lead) users matching the distinct persona profiles were recruited (N=11) for further qualitative exploration. In the *third* and last *research phase*, these 11 respondents participated in creative home sessions using the cultural probing technique. Different tools were used to collect information and experiences for projecting the personas in the future as a way to explore, imagine and create 'future TV experience'-scenarios.

Results and policy impact/implications

In *Study 1*, 3563 from the 11802 respondents reported unfulfilled needs or ideas related to DTV. The majority of ideas dealt with rather common applications and features. Through further analysis and clustering, we identified 13 unique ideas representing important unfulfilled needs, which were reviewed by the expert panel. High potential ideas (however already in relatively advanced stage of development) were e.g., the 'remote digicorder', 'visual EPG' and 'exchange of user-generated content through DTV'.

Main lessons learned from Study 2 are that – through a combination of methods and in an inclusive IF process involving several stakeholders – daily practices as well future aspirations and opportunities can be better understood, detected and used as an input for (further) development. Not surprisingly, the more advanced TV users, i.e., the 'positive personas' were found to be relatively enthusiastic and open about future TV experiences inducing innovative sensual experiences (e.g., scent TV, holograms, and connected multiple screens). Both studies represent examples of IF activities in which the idea of social shaping of technology by and for (future) users is put into practice.

Conclusions

In this paper it is argued that through information, imagination, intelligence and continuous interaction, IF activities with different types of (prospective) users and stakeholders can be used as a strategic and anticipatory tool. Such activities can contribute to a better articulation and inclusion of future users' and societal needs, successful detection and anticipation of

unexpected forms of use, identification of future innovation opportunities, setting of strategic research priorities, prevention of lock-in, etc.

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FUTURE OF STRATEGIC FORESIGHT

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Keywords: Strategy, Foresight, Horizon Scanning, Futures, Planning, Risk, Innovation, Technology, Systems, Intelligence, Collaboration.

Introduction

This paper describes the systemic methods, process and approaches to foresight, innovation and risk management being developed by many leading commercial organisations, not-for-profits and governments and around the world. It describes a now integrated and increasingly shared technological approach to open source and third party intelligence gathering, trend analysis, sense-making and path finding used by these organisations to shine a light on the possible future of strategic foresight.

Methodology

The paper describes the current capabilities of the shared system, where organisational demand for collaborative foresight, innovation and threat management is moving in the future and what developments can be expected in the next five years.

The approach was developed in response to demands for an automated organisational foresight process through a single collaborative system. Over the years' many organisations have shared their collaborative innovation, risk management and foresight process, needs and desires to create this system with the author and his organisation. Significant contributions to the development of the system have also been made by leading futurists, academics and consultancies engaged in these activities. The extraction of best practice from journals, articles and conference papers has also played a major part as have the ideas of users, intense trend watching and fast development of best practice web technologies.

Results and policy impact/implications

Strategic foresight practitioners are likely to see:

- improvements in user profiling and filtering of Insights and Trends analysis. This will allow the use of sophisticated narrative analysis tools to make sense of user data e.g. by industry and personal interests

- greater innovation through formal ideation processes; innovation and risk assessment systems are already converging with strategic foresight

- the creation of global scouting networks and expert panels

- integration with business and competitive intelligence and prediction market systems

- integration of foresight tools and methods (e.g. futures wheels, road mapping etc.)

- a move to automated scan hit finding as capabilities improve but still with human input

- web-based modelling and simulation

- the arrival of fast action/reaction/low cost/high value added intelligence systems

- melding of strategic foresight into new delivery channels such as virtual worlds and games

- cross-over to more design led methods of presenting and working with the future

Conclusions

As early adopters learn to use the new tools and further develop existing capabilities it is expected that a global strategic foresight brain will emerge within the next decade. The requirements for such a global brain are myriad but the tools and knowledge are now there to make this holy grail of foresight a real possibility

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- Questions for the future

- Future Technology (slideshare: registration required)

FORESIGHT IN AN UNPREDICTABLE WORLD

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Keywords: unpredictability, disruptive innovations, grand societal opportunities, creative evolution, foresight methodology, epistemology and ontology of futures studies.

Introduction

We know that foresight and planning exercises have generally missed important technical and techno-economic developments, recent examples being, for example, the rapid expansion of SMS messaging and social computing platforms on the Internet. Despite extensive planning and foresight, policy and technology experts typically have been blind to many important social, technical, economic, and environmental developments.

Future is unpredictable. We almost never get it, and almost always get it wrong. Although the large variety of accumulated visions of the future often cover even the most eccentric alternatives, rational argument and consensus rapidly converge foresight towards strange attractors that rarely represent the hot-spots of actual futures.

The paper claims that unpredictability can be more radical and conceptually more important than many foresight experts have expected. Deep unpredictability is a mirror image of creative evolution and disruptive innovation, and cannot be effectively reduced by collecting more information or facts. The essence of the Knowledge Society is in its high capacity to create new knowledge and new meaning, and policymakers need to embrace unpredictability, instead of trying to minimize it. To understand the impact of deep unpredictability, the paper explores the basic ontological and epistemological concepts that underlie foresight and FTA.

The paper thus makes a conceptual and methodological contribution to FTA. In addition, it applies the presented analysis in the current historical setting, arguing that foresight needs a paradigm shift in the Knowledge Society. Foresight has been strongly associated with Industrial Age models of impact, and foresight activities have relied on information that has been collected using categorizations and measurement systems optimized for the Industrial Age models of production. The claim is that this has been one of the reasons why foresight has systematically missed important future developments. The epistemic models of most foresight and FTA activities inherently assume a world that evolves as an extrapolation of the past. The creative and truly novel aspects of the future thus remain beyond their reach.

The fundamental source of deep unpredictability is the creative nature of evolutionary and innovative processes. Deep uncertainty is the key source of innovation, growth, and value creation in the emerging knowledge society. To tap it we need to give up some basic instincts that have driven planners, forecasters and strategy developers during the last century.

Future has never been deterministic. Extending the neo-Schumpeterian analysis of techno-economic paradigms, the paper, however, claims that in the last century the future was deterministic enough to produce constructs of causality, time, subject, object, and value that successfully reflected the requirements of the dominant model of production. The Industrial Age and its mass production methods also produced determinism as their own condition of success and viability, thus facilitating a particular mechanistic reification of these constructs.

The emerging new context for foresight can be best described using models of creative evolution. These may be contrasted with the adaptive Darwinian models of evolution that have typically been used in economics. Creative evolutionary models emphasize the creative aspect of living systems. The underlying ontological model can be characterized as phenomenological. In such models, evolution continuously generates new epistemological and ontological domains.

Creative models of evolution become particularly relevant for FTA when innovation is understood as a dynamic process in socio-technical ecosystems. Creative models of evolution generate ontological domains that are phenomenologically new. Such emergent domains cannot be fully described using constructs that characterize previously existing domains. They therefore represent discontinuous change and disruption that make conventional prediction impossible. The challenge of phenomenological unpredictability can not be solved by collecting more information, processing more data, or by developing more sophisticated models.

Results and policy impact/implications

"Grand challenges" can only be articulated by extrapolating historically important categories and data towards the future. The idea of "grand societal challenges" is therefore inherently backward looking, and frames policy in a way that potentially misses truly novel opportunities of the future. The articulation of "grand challenges" requires special care when policy is implemented using transformative technologies, such as ICTs, which through their pervasive impact also change the framing of problems. The present paper argues that foresight methodologies need to be reconsidered to overcome this systemic blindness and to effectively support policy-making.

For example, the ageing of populations in the EU has frequently been understood as a challenge. Ageing becomes a grand challenge mainly because we assume that Industrial Age production and value creation models, work patterns, and public financing systems remain as they used to be in the 20th century. There is little reason to believe that these assumptions will be valid under the conditions of the Knowledge Society. For example, elderly people might well become main contributors to socio-economic development in the future. Similarly, the challenge of global warming is typically framed in a context where socio-economic development requires more production that is visible in the current national accounts and GDP, as well as more energy consumption. Industrial Age logic provides the foundation for this framing of the problem. This leaves open the key policy question what we mean by growth and value creation in the emerging Knowledge Society.

Conclusions

When the intensity of innovation increases in the Knowledge Society, deep unpredictability becomes a critical constraint for future-oriented analysis. Foresight professionals and policy-makers need to understand the nature and the implications of deep unpredictability. This requires that we reconsider the epistemic and ontological assumptions that underlie much of current foresight and future-oriented analysis.

ORIENTING RESEARCH AND INNOVATION POLICIES TOWARDS GRAND SOCIETAL CHALLENGES: THE ROLE OF FTA IN ANTICIPATING DISRUPTIVE TRANSFORMATIONS

Martin Rhisiart

Abstract

Future-oriented Technology Analysis has been used to support Research and and Innovation policy in a number of contexts around the world. A number of techniques have been used to explore the possible future development and exploitation of technologies, such as Roadmapping and Delphi. FTA has, over recent years, been challenged to address the increasingly complex nature of research and innovation policy as a result of factors such as globalisation, converging technologies and democratised and open innovation. Moreover, the shift of emphasis away from single-focus technology exercises to multi-disciplinary, societal challenges presents new questions and new opportunities for FTA. This paper analyses some recent developments in how national research and innovation systems use FTA and other Foresight approaches to construct responses (such as new investment priorities) to emerging global challenges and opportunities. It draws on international examples of FTA used for research and innovation policy agenda-setting, including recent research conducted by the author in Ireland and the UK. It will relate the methodological approach taken in one such project in Ireland – in identifying research implications of global drivers and trends, which combined analysis of global changes with a participatory process involving national stakeholders. The exercise was designed to assess the implications of global changes for research, particularly in addressing grand societal challenges. This forms part of on-going research by the author into international use of FTA to inform research and innovation policies that have been challenged increasingly to become oriented to societal challenges or imperatives. The key questions and themes addressed include the following. How is FTA being used by governments and organisation to anticipate and shape transformations – particularly those that are relevant to the domain of macro, systemic challenges? To what extent will FTA create a transformation of the enabling research and innovation system? What are the strategies that FTA designers and practitioners might need to adopt in broader governmental and organisational discourse and decision-making around 'grand societal challenges'?

GLOBAL URBAN SANITATION SYSTEM HOTSPOTS: MASS MARKETS FOR DISRUPTIVE ONSITE WASTEWATER TREATMENT TECHNOLOGIES? AN EUROPEAN PERSPECTIVE

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Keywords: technology roadmapping; disruptive technologies; innovation system analysis; decentralized infrastructure systems; waste water.

Introduction

Cities in newly developing countries (NICs) are often facing a serious problem constellation for the installation of the necessary water and sanitation infrastructure: in particular, very fast growth of settlements, low water availability and massive lack of existing infrastructure. These preconditions make the dominant technological system of large sewer networks with huge central wastewater treatment plants less appropriate which is nearly ubiquitously established in western industrialized countries. But new concepts of decentralized onsite water treatment technologies (OST) could be a promising alternative.

OST represents a radical and systemic innovation for urban water management. Their contribution to a future more sustainable sector structure depends on an interrelated set of social and technological development processes addressing material components and their system integration, corresponding industry and servicing structures as well as their embedding into institutional contexts.

The OST project is a scoping project for inter- and transdisciplinary research on onsite treatment systems in urban water management. This paper is presenting a technology roadmapping exercise from water scientists together with representatives of water technology providers and further experts to figure out the perspectives of the development of this disruptive sanitation technology. It tries to answer the questions: 1) where are the potential markets where OST has competitive advantages compared to the dominating design of central sewer systems, 2) how should the OST products and their business concepts look like, 3) who are the actors with the knowledge for the product development and implementation and 4) which research and development steps and further activities are needed to bring the OST technology into a mass market.

Methodology

The OST project methodology is a mixed method approach following an advancement of the Innovation System Analysis procedure (Markard et al 2009) and the Technology Roadmapping approach (Phaal, Müller 2009). It starts with a global hotspot analysis of the regional spread of problem conditions which can be interpreted as competitive advantages for radically new infrastructures. In the second step a technological variation analysis with different configurations of OST technologies is carried out to present different future perspectives of this technology. In the third step a variety of industry partners and further experts who could contribute to the development of disruptive OST systems are identified and interviewed on their perception of the future dominant design for OST. At last, a selection of these industry actors was invited to a two day roadmapping workshop to develop potential future dominant designs for OST, which could be contributions to the sanitation infrastructure needs in NICs' cities.

Results and policy impact/implications

The technical results can be shortly described as (1) conventional on-site wastewater treatment, (2) wastewater treatment with moderate water consumption and recycling for outdoor water reuse, and (3) highly water efficient systems with extensive source separation. While the first is close to technologies which are already at the market, the second and third one need heavy further research and development. All of them require new operational modes to have the plants under control and make them more reliable and robust. This can be a central operation of decentralized plants with remote sensing control or variants of this concept. The business model of the technology provider has to shift from the product producer to a service and operation provider. To cover the international markets European firms have to develop concepts for international presence e.g. with a partner network. The technology providers have to act as educators for their partners and as their extended knowledge and service pool.

Conclusions

Introducing disruptive technologies is not a problem of static choice of technologies. It is a dynamic process of learning of potential industry actors about valuable markets and chances for new businesses. Up to now, only a limited number of niche specialists have pioneer expertise in this field. Most firms see options for incremental improvements of the existing products and do not take the chance to implement these solutions far beyond the European market.

Disruptive technology development like OST can not to start from scratch. In order to develop these promising technologies into mature alternatives, a highly concerted action would be needed, probably in the same order of magnitude that was necessary to build up the centralized systems in the first place. Such a program will require a broad political discussion on future challenges in urban water management on a global scale. It will involve engineers as well as social scientists, industry representatives and policy makers. Such a program has to truly build on interdisciplinary competencies as it has to simultaneously anticipate social, technical and economic aspects of a systemic innovation process (Truffer et al forthcoming).

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THEME 2:
BUILDING FTA CAPACITIES FOR SYSTEMIC AND
STRUCTURAL TRANSFORMATIONS

Theme 2
Building FTA Capacities for Systemic and Structural Transformations

The increased incidence of disruptive events and scientific discovery in recent years is driving governments and businesses to scale down FTA activities, shifting from individual large-scale foresight programmes and projects, to invest in developing in-house competencies for coping with sudden change. This capacity-building drive is primarily aimed at addressing specific societal trends, concerns and needs as well as identifying the means to optimise on social innovation and related opportunities. Apart from a renaissance of parliamentary technology assessment, the development towards institutionalisation of foresight is reflected in the setting up of horizon scanning centres and dedicated foresight units in firms and public administration.

The reasons for this shift from projects and programmes to institutionalised forms of FTA are manifold. On the one hand, a tighter embedding of FTA in support of decision making is needed in the light of a fast-changing, turbulent and complex environment. This is, rendering the interpretation of contextual developments very difficult and challenging. On the other hand, there are internal reasons why novel forms of future intelligence are needed, ranging from the need to provide solutions in time to achieve coordinated and coherent decisions within and across organisations. As a consequence, there is a growing need for the capacity to anticipate change to be centrally embedded in policy and decision making, and to achieve this embedding quickly and strategically.

While the trend towards institutionalisation of FTA may appear obvious, it is important to understand the advantages and disadvantages of different organisational models along the lines of which FTA can be set up. The implementation of individual FTA projects or programmes of a limited duration and with a targeted objective can be seen as the alternative model to the establishment of dedicated FTA units providing continuous input to their embedding or mother organisations. Different combinations of elements from these ideal-type models are possible as well, such as (international) FTA networks as informal but nevertheless stable settings allowing to bundle or coordinate resources and competencies.

It is also important to highlight that these models are complementary in many respects. Service providers as well as FTA institutions need to be able to draw on networks for many purposes, and the boundaries between service provision and institutionalised forms of FTA are blurring. The balance between these three forms of FTA activities (i.e. external FTA services, institutionalisation of FTA, and FTA networks) in empirical terms requires further investigation, in order to understand how effectively different combinations of activities work in their respective decision making context. In the very end, the most suitable model of FTA will strongly depend on the wider institutional and organisational environment in which FTA is embedded, be it in the private or the public sector.

Against this background, it is important to improve our understanding of how far institutionalised FTA can form part of the solution for building capacity to handle disruptions. Many sorts of combinations of elements from different organisational models are needed to enable learning, experimentation and capability development appropriate for the wider decision making context in which FTA is embedded. This conference theme is aimed at exploring the extent to which FTA can provide enhanced support to decision making through different organisational models for capacity building, generation and assessment of future developments, and corresponding abilities to transform organisations, thus enabling them to anticipate and address identified challenges and emerging weak signals. Therefore, papers and posters under this theme are expected to address, but not be limited to, the following areas of work:

- Organisational models for building anticipatory capacity to manage disruptive and transformative change as a support to decision making including experiences with change management;

- The role of supporting 'infrastructures' for conducting FTA within and across private organisations;

- Embedding of different forms of FTA in the public sector and implementing FTA results into policy and decision making, e.g. ex ante impact assessment and trend monitoring of performance indicators;

- Advantages and drawbacks of centralised and distributed forms of institutionalising FTA activities;

- Provision and use of horizon scanning functions in different contexts and at different governance levels: results and experiences from practice;

- Evaluation and impact assessment of FTA as a source of legitimacy.

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BOTTOM-UP EXPLORATION OF STRUCTURAL TRANSFORMATION: LESSONS FROM A FORESIGHT EXERCISE ON THE FUTURE OF INNOVATION

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Keywords: Innovation Patterns, Innovation Futures, Foresight, Signals.

Introduction

With this paper we would like to contribute towards „building FTA capacities for systemic and structural transformations" as suggested by theme 2 of the 2011 FTA conference. To this end we will discuss experience from an ongoing Foresight project that is exploring future innovation patterns. The INFU (Innovation Futures) project[1] is financed by the European Commission in the 7th Framework Programme. It is investigating emerging new patterns of innovation characterised by fundamental transformation in the way innovation is organised.

Methodology
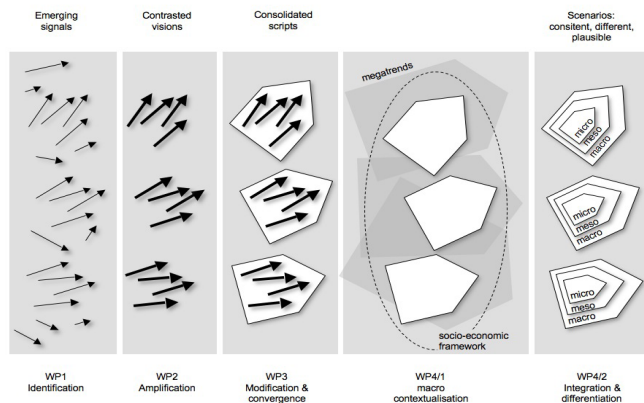
Figure 1: INFU Methodology Scheme

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1   http://www.innovation-futures.org/

INFU is exploring the future of innovation in a bottom up approach (figure 1). In the first phase, all sorts of observations of striking innovation practices were collected in a loose and open manner. From these signals of change, 20 contrasted visions on the future of innovation were generated by clustering and "amplification" (figure 2). These provocative projections were discussed with actors with different perspectives on innovation patterns through interviews and an online survey. On the base of all reactions on the contrasted visions seven "nodes of change" were identified.

Figure 2: Three INFU Contrasted Visions

These nodes of change were then subjected to in-depth discussion within the INFU mini-panels formed by groups of actors with a specific interest in these patterns of innovation. Only in the last phase of the INFU project the nodes of change have been linked to widely perceived changes on the macro environment in a scenario building process where several actors from the previous phases participated. Throughout the process, INFU placed high emphasis on visualisation in order to mobilise out-of-the-box thinking.

Results and policy implications

The INFU findings indicate interesting changes in the mediation between innovation demand and innovation supply. A wide variety of hybrid value creation models with novel configurations of innovation actors emerged. Prominent issues across mini-panels were the emergence of more active roles for users and citizens, the need for adequate enabling platforms between innovation demand and innovation supply, the need to adopt new innovation formats in order to address societal needs and the increasing use of self-production facilities such as 3d-printing. These findings imply new topics and approaches to innovation policy making as outlined in the INFU policy briefs. Some of the proposed aspects of new innovation patterns such as the "waste based innovation" or the "city level open innovation platform" seem particularly suitable for aligning social and technological innovation towards structural transformation.

Conclusions

The innovative bottom-up INFU methodology succeeded in opening up new perspectives on the future of innovation with relevance for society, business and policy. In particular, the INFU findings may provide useful insights for innovation strategies directed at structural transformation for addressing the Grand Challenges such as the Innovation Union Initiative. From a methodological point of view it will be highly interesting to see how the integration of findings into consistent scenarios of innovation landscapes in the next project phase will proceed.

Innovation Policy Roadmapping as a Systemic Instrument for Policy Design: Examples from Victoria Australia

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Keywords: innovation policy, roadmap, systemic instrument, policy design, Victoria, Australia.

Introduction

In formulation of national and regional innovation policies, there is a growing need to align perspectives of technological and societal developments towards a more visionary framework, i.e. a structure that steers policy formulation towards co-created, shared and explicitly stated future goals. In this paper, we present the concept of innovation policy roadmapping (IPRM) which adapts the methodology of more traditional technology roadmapping (TRM) to addressing critical innovation policy challenges at the level of national and regional innovation systems, within a global context.

Methodology

There are three features that separate IPRM from more traditional TRM. Firstly, IPRM is targeted at the systemic level of multiple actors and organisations. Thus the visionary process includes many participants and different interests. This obviously sets some challenges to the organization of the process. Secondly, IPRM combines the structure of more traditional TRM – including such contents as enabling technologies, applications, products, markets and drivers – with empirically investigated view of the policy instruments currently utilised in the innovation system under scrutiny. Hence the nuanced knowledge of the policy context and related practices is of paramount importance. Thirdly, IPRM underlines the activities in the sphere of innovation policy throughout the process, i.e. the outcomes of the process can be e.g. strategies to implement a novel policy instrument or a strategy for a region to engage in an active market creation in the context of some promising emerging technology.

Results and policy impact/implications

As an empirical case we present a selection of results from the IPRM exercise carried out in Victoria, Australia in 2009. The project was commissioned by DIIRD (Department of Industry, Innovation and Regional Development of Victoria) which is a state government agency

responsible for innovation and industrial policy of The State of Victoria. The project was carried out as collaborative undertaking by VTT Technical Research Centre of Finland and ICS (Intellectual Capital Services Ltd.). Project aimed at identification of key emerging technology trends by year 2020 that could be utilised as a source of sustainable competitive advantage in the future. Specific emphasis was laid on the aspects of emerging technologies, technology convergence and on the concomitant innovation policy conclusions. The project produced detailed roadmaps of nine sectors of industrial technologies. In this paper we focus on how the method stimulates systemic transformation at different spatial levels. To flesh out this process, we present selected examples from three roadmaps: 1) building & construction, 2) packaging & paper and 3) scientific, industrial and medical instruments. With these examples, we illustrate how responding to grand challenges can be facilitated by a systemic roadmapping process with an explicit aim to facilitate emergence of new innovation dynamics.

Conclusions

Aligning the perspectives between development of new technologies, business models, socio-technical systems, and policy instruments lies at the core of our approach. We conclude by assessing the future potential and challenges of the IPRM approach.

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THEME 2A: SYSTEMIC AND EMBEDDED FTA

IMPLEMENTING SYSTEMIC RTI PRIORITIES: RECENT EXPERIENCE FROM GERMANY

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Introduction

The paper is addressing theme 1 and 2 of the FTA call for abstract in an integrated manner. We set out from the assumption that – due to the intrinsically systemic nature of the "grand challenges" - a key requirement for "orienting innovation systems towards global challenges" is to "build capacities for structural and systemic transformation".

We focus on Foresight a systemic innovation policy instrument that has long been recognised for its ability of not only "wiring up" but also "orienting" innovation systems (Martin, Johnston 1999). Dealing with structural and systemic transformation poses several challenges to Foresight theory and practice. Imagining "change in the conditions of change" (Miller 2007) rather than just extrapolating the present and recognising the complex interplay of society and technology in a systemic manner (Warnke, Heimeriks 2008) both require a strong methodological framework.

In this paper however we focus on the post-Foresight phase. In particular, we explore the challenges involved in embedding innovation priorities that are directed at "structural and systemic transformation" into the innovation landscape and in particular policy strategies. As an empirical case we investigate the follow-up activities of the BMBF-Foresight-Process that was carried out in Germany from 2007-2009 and proposed a set of cross-cutting and systemic long-term priorities for German innovation policy (Cuhls et al. 2010, Bode, Beyer-Kutzner 2010): the "new future fields". The follow-up activities were launched by BMBF in order to underpin the implementation of the Foresight's findings.

Methodology

The following core elements form the BMBF-Foresight implementation phase:

- o strategic dialogues with key actors inside and outside the ministry
- o a "monitoring system" observing the "new future fields"
- o an integrated evaluation process

The strategic dialogues aim to foster the embedding of the suggested "future fields" into the German RTI landscape. In order to realise the systemic perspective of these priorities, actor

strategies that are currently organised around technology fields or in disciplinary settings are being aligned into novel transformative approaches throughout the RTI landscape including BMBF itself and other ministries.

In parallel, the "monitoring-system" is observing the new future fields. In order to be able to assess a potential future innovation arena that is not yet established, classical scientometric methods such as patent or bibliometric analysis cannot be directly applied. Accordingly, the system deploys an innovative semi-quantitative assessment approach which is based on a morphological box with four different dimensions which are continuously observed and assessed in a half-yearly status report.

Results and policy implications

Currently, the follow-up activities are focussing on two "future fields": Human-Technology-Cooperation and ProductionConsumption2.0. Several dialogues have taken place and the monitoring system has delivered its first status report. Whereas all indicators are pointing towards the continued need for both the systemic innovation priorities, the observation of the implementation indicates that the main challenge to putting transformative innovation priorities into practice is the strong embedding of established disciplinary and non-systemic perspectives into the very structure of RTI landscape across all levels and realms. In particular integrated research across social sciences and humanities on the one hand and natural science and engineering on the other, which is required for both priorities, encounters institutional barriers.

Conclusions

The experience from the BMBF-Foresight's follow up activities suggest that in order to address structural transformation through demand oriented RTI priority setting, as it is requested by the "Lund Declaration" and Europe2020 Strategy, we need to address the institutional dimensions of these transitions in our FTA capacity building as it has been done by BMBF. Otherwise it does not seem likely that RTI programmes will pay more than lip service to the "grand challenges" of our time.

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EMBEDDING FORESIGHT IN THE JOINT PROGRAMMING PROCESS FOR RESEARCH

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Keywords: Transnational R&D collaboration, priority setting, foresight, Joint Programming, European Innovation Partnerships.

Introduction

This paper looks into the role of foresight as a decision support tool in international agenda setting and resource allocation, with a particular focus on how it could be institutionalised and embedded in research and innovation decision-making settings shaped by a wide variety of scientific, social, economic and political factors. In particular, the paper focuses on Joint Programming (JP) in Research, which is seen as key to the realisation of the European Research Area (ERA) and crucial to the success of efforts to address many of the major societal challenges that the EU and the world are facing.

At its meeting of 26/11/2010, the Competitiveness Council invited Member States to define the role JP could play in terms of realising the aims of the Europe 2020 strategy. It also invited to comment on the ways in which JP could relate to the concept of European Innovation Partnerships. The role Future-oriented Technology Analysis (FTA), particularly foresight, could play in the future development of JP is discussed within this overarching policy context.

In theory, foresight has the potential to be an essential ingredient of JP, especially in terms of facilitating the early identification of emerging issues and informing the selection of appropriate themes for JP, but it could also be important at other stages of the JP process (e.g. vision building, development of a strategic research agenda, implementation etc.). To date, however, foresight has not been a key feature of JP, especially in terms of priority setting, which has been influenced in different ways in different settings by the often contradictory priorities of different communities, e.g. the scientific and political communities. Based on an examination of the way in which foresight has been used to shape other types of transnational collaboration, however, this paper argues that foresight constitutes an exemplary way of exploring and resolving potential conflicts between different drivers, thus helping to construct a sound bedrock upon which JP can be founded.

Methodology

By examining recent examples of the use of foresight to shape different forms of transnational cooperation in research and innovation, a methodological framework is developed that distinguishes between contextual, outcome and process driven objectives for establishing foresight activities. Our methodological framework is used to evaluate the design, management and impacts of recent foresight exercises related to ERA-NETs, Technology Platforms and other forms of transnational collaboration.

We also explore how foresight activities can support decision-making via the construction of crucial repositories of knowledge, which opens the door to a discussion of 'embedded foresight'. Building on hands-on experience gained whilst contributing to the development of the voluntary 'Guidelines on Framework Conditions for Joint Programming', we discuss different options for embedding foresight in JP in a flexible way that harnesses its potential for conflict resolution and consensus building whilst still preserving its ability to stimulate creative thinking and suggest alternative ways forward.

Results and policy implications

The results of the analysis support our initial hypothesis that, in addition to its role in the identification and elaboration of relevant topics for JP, foresight can help build stakeholder commitment. In particular, it provides systemic understanding that better allows Member States to position JP initiatives in the European System of Research and innovation, and it facilitates the development of new coalitions that can support the creative and effective implementation of JP. In terms of policy implications, some suggestions are offered concerning the ways in which foresight can be used to avoid duplication and create synergies between JP and the processes involved in establishing other transnational initiatives, e.g. European Innovation Partnerships, and suggestions are formulated concerning ways of embedding foresight in institutional structures. More generally, the analysis deepens our understanding of what foresight can offer to joint agenda setting and resource allocation in different international contexts.

Conclusions

The paper offers new insights into the roles foresight can play in international priority setting and, more specifically, in the selection and implementation of JP initiatives. It elaborates a conceptual framework that is used to analyse recent foresight activities relevant to JP. Institutional bottlenecks to the use of foresight in JP are identified and ways of overcoming them elaborated. The role of foresight vis-à-vis the establishment of effective links between JP and the development of European Innovation Partnerships is also covered.

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Application Of Foresight Methods For The Determination Of Priority Research Directions Of The Future

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Introduction

Innovativeness and competitiveness of the advanced product and process technologies are the basic factors deciding on the directions and the pace of the development of contemporary knowledge-based economy. The need to identify the priority research areas, and the advanced technologies of the future, are determined by their key role in the economic and social growth of a country. Foresight projects are an effective tool applied in the identification of economic, scientific and technological priorities, future technologies and the creation of the vision of their development.

The article presents methodology of forecasting research directions crucial for the development of the competitiveness and innovativeness of the Polish enterprises and technological institutes. Application of the methodology is presented on the basis of environmental technologies, one of the key areas of technical support for the economy's sustainable development.

Methodology

The approach considering the micro scale, understood as the generation of the research directions realised at the R&D institutions, as well as the macro scale composed of the national strategic directions inspired by, among others, the results of the Polish sectoral foresight projects and European directions inspired by the strategic documents of the European Union, the results of foresight projects realised abroad and of international research projects, was adapted when generating the future research directions. Moreover, it was assumed that the priority directions would be set with the simultaneous consideration of the existing scientific and technological potential and its predicted growth in the specific time scale needed for the realisation of R&D tasks planned.

Among the key mechanisms of generating future research directions were the analysis of the state-of-the-art and the expert analyses.

The analysis of the state-of-the-art was done in the iterative system and formed the basis for the identification of priority research directions, within which the literature analysis of the current state-of-the-art allowing to determine the most important, and previously not incorporated research directions was conducted. The verification of the priority research directions was thus possible. The description of the state-of-the-art included both the cognitive performance of Polish, European or international scientific institutions leading in a given domain and the technological achievements resulting in innovations complying with global world wide standards and ready to be commercially deployed.

The aim of the expert analyses was to support the analysis of the state-of-the-art. External experts representing the science, industry and public administration sectors, who had not participated in the initial identification of future research directions, assessed the priority research directions in the scale of the country and the sector. The consideration of the experts' remarks enabled the modification and extension of the proposed research directions, and in consequence the selection of new future research directions.

Results and policy impact/implications

The results obtained embrace general research directions on the national and global level and integrated groups of these directions, including both incremental and emerging technologies in a selected area of strategic importance comprising environmental technologies.

The proof of the successful implementation of the methodology developed, is "Innovative Systems of Technical Support for Sustainable Development of the Country's Economy" strategic project launched in the thematic area generated with the use of the methodology designed, co-financed from the European structural funds, prepared and co-ordinated by the Institute represented by the author of the paper.

Conclusions

The proposed methodology enables the generation of future research directions which support the sustainable economic development and are supposed to be realised at the R&D institutions in a short and long-term and include the incremental and emerging technologies together with the research directions integrated with them that are likely to be undertaken by other scientific centres and the technologically advanced enterprises. The proposal of operational activity, within the formula of strategic programmes, directed at the practical realisation of the selected novel research directions has been presented. The currently built computer system equipped with the module of the short and long-term prognosis is a useful tool supporting the forecast of innovative technologies and research directions.

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SOCIAL ATTITUDE TOWARD SUSTAINABLE DEVELOPMENT IN 2025: A CASE FOR REINFORCING SCENARIO DESIGN

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Introduction

This paper shows the role that some foresight tools, such as scenario design, may play in exploring the future impacts of global challenges in our contemporary Society. Additionally, it provides some clues about how to reinforce scenario design so that it displays more in-depth analysis without losing its qualitative nature and communication advantages.

Since its inception in the early seventies, scenario design has become one of the most popular foresight tools used in several fields of knowledge. Nevertheless, its wide acceptance has not been seconded by the urban planning academic and professional realm. In some instances, scenario design is just perceived as a story telling technique that generates oversimplified future visions without the support of rigorous and sound analysis. As a matter of fact, the potential of scenario design for providing more in-depth analysis and for connecting with quantitative methods has been generally missed, giving arguments away to its critics.

Based on these premises, this document tries to prove the capability of scenario design to anticipate the impacts of complex global challenges and to do it in a more analytical way. These assumptions are tested through a scenario design exercise which explores the future evolution of the sustainable development paradigm (SD) and its implications in the Spanish urban model.

Methodology

Following the conventional scenario design methodology, 3 scenarios are built for the year 2025.

> **Scenario A: Green Paradigm**. It takes place when there is a favourable response from public and private agents toward SD and there are sufficient resources required

to achieve sustainable development. "Green Paradigm" stages an environmentally conscious society, in which most citizens participate in public decision-making.

Scenario B: Predator Development. It occurs when resources of all types are abundant, but at the same time public and private agents have either a slow or a passive reaction to sustainability challenges. "Predator Development" represents a society that disregards environmental issues as noncritical, compared to its consumption needs.

Scenario C: Back to Basics. In this scenario, there is a significant shortage of resources due to a prolonged recession, but at the same time, the Spanish society as a whole supports sustainable development models. In "Back to Basics", public and private agents are fully conscious of the need for sustainable development.

Results and policy impact/implications

Most scenarios exercises are finished with the description of geopolitical, economic, societal and technological contexts. Regardless of their ingenuity and descriptive details, this kind of output is generally perceived as insufficient and trivial by most urban planners. In order to reinforce the perception of scenario design as a useful and added value instrument, a more profound analysis is displayed by determining the scenarios implications in a small territory located in the periphery of Madrid metropolitan area. This process follows three steps:

1) *Scenarios functional implications*. A conceptual framework displays the overall urban planning process. This framework is made up of a value chain supported by a group of horizontal elements, such as governance model, legal framework, technology base, and management skills.

2) *Scenarios parametric implications*. A set of urban parameters is activated to show quantitative implications of diverging scenarios regarding sustainable development. Parameters are estimated through diverse forecasting tools.

3) *Scenarios spatial implications*. Alternative images of urban growth, infrastructure networks and land use patterns are shown. With adequate resources, a GIS related software can be incorporated to simulate the scenarios development patterns.

These three sets of implications provide substantial and in-depth information for policy makers.

Conclusions

This study provides five major sets of findings. First, it is feasible to set up a systematic approach that provides anticipatory intelligence about future disruptive events that may affect the natural environment and socioeconomic fabric of a given territory. Second, certain life styles and economic models present long-range implications on the attainment of a more sustainable urban development. Third, there are opportunities for innovating in the Spanish urban planning processes and city governance models. Fourth, as a foresight tool, scenario design can be substantially reinforced if proper efforts are put to display functional, parametric and spatial implications generated by the scenarios. Fifth, the study confirms that foresight offers interesting opportunities for urban planners, such as anticipating changes, formulating visions, fostering participation and building networks.

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A BUSINESS FRAMEWORK FOR BUILDING ANTICIPATORY CAPACITY TO MANAGE DISRUPTIVE AND TRANSFORMATIVE CHANGE AND LEAD BUSINESS NETWORKS TOWARDS SUSTAINABILITY

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Introduction

The paper suggests a dynamic framework of continual learning to enable businesses to develop a capacity to anticipate and address change within the networks in which they are embedded, using FTA thinking to shape businesses path towards sustainability.

The proposed framework has been devised to enable firms to become a participant who helps shaping the path to a common vision within its network being flexible enough to adapt to the changing circumstances of the environment and of its relationships. Ultimately, it should enable firms and their networks to behave like sympoietic systems, which are complex, self-organising but collectively producing, boundaryless systems that are evolutionary, distributively controlled, unpredictable and adaptive [1].

Methodology

The main question is 'how can businesses be helped to follow a sustainable development path'? The study reflects this question and meets the final main objective to build a management framework to support enterprises in shaping a common vision for sustainability to be pursued across its network of business and regulatory relationships by anticipating and addressing change.

The research uses a qualitative approach [2], the elements of which are described from the perspective of the intended case studies [3]. The latter used, as a main tool, structured interviews with key actors inside the chosen companies.

The study was designed [4] to enable a comparison between a regulated and a non-regulated firm. The idea was to understand if there was any difference between (a) the vision of key individuals inside each organisation with respect to what is necessary to create a path to sustainable development, and (b) if the different framework conditions between the enterprises would also create differences concerning what was considered necessary for the development of a sustainable business.

Both an individual and a common 'map' linking the identified business activities and the information flow among them was developed for the two organisations: this was done using the IDEF_0 method [5] supported by interviews with key actors inside the organisations to validate all information.

The Delphi Technique [6] was also used to validate the case studies results by submitting it to a number of experts for comment and to ensure that all the important variables, information, technologies and elements were included on the final model.

Results and implications

The Delphi exercise produced enough information to develop a critical path to help businesses to progress in the direction of sustainable development (i.e. maturity model): this was developed using the CMM methodology [7]. Through the identification of different levels of responsibility/ sustainability it was possible to design the management framework to help businesses to develop, together with partners, their path to sustainable development and ways to move in that direction [8].

The management framework links the activities that need to be performed at each stage of the business to build an organisation's ability to know itself (how things are done in the present). From this self-knowing, a business will be able to design the necessary actions to achieve the desirable future (how things should be done according to the business' and its network's vision). It is the process of seeking, in the present, to bridge continuously the gap between the present and the future, which is believed to enhance and enable businesses to sustain competitive advantages and follow a path to sustainable development.

The learning process embedded in the proposed management framework differs from those in existing management tools. It becomes a continual process which takes place during each implementation cycle. Hence, when a new cycle is about to begin the enterprise will be armed with better and clearer opportunities to make an evolutionary leap in sustainability performance in alignment with partners. The basis of this evolutionary leap is in the ability to build a continuous, collaborative learning process founded on an inclusive and active dialogue among all stakeholders, which can be translated by the firm's capability of developing a 'meta learning' [9] process in the network.

Conclusions

A model of sustainable business activity was devised by unlocking the value activities within a firm's network through the analysis of CSR in theory and practice, as well as the analysis

of the important features needed to build a firm's sustainable competitive advantage. By incorporating three business management principles – do things right the first time; do the right thing; and continuous improvement and innovation – a management framework was designed. This is a dynamic tool that evolves together with the learning process within the network in which the organisation is embedded and seeks to enable an alignment of social-environmental strategies with the core business strategy across the network, clarifying the connections among the value activities in the network. The objective is to help firms' networks to achieve a sustainable business performance. Also, to help organisations to create a tailored, as well as a common strategy in its network of relationships, achieving influence among its partners to progress towards higher levels of sustainable development, in order to achieve the desired common vision of sustainability.

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SOCIAL BUSINESS AS FUTURE INSTITUTIONAL TECHNOLOGY IN EUROPEAN COUNTRIES

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Introduction

In recent years, industrialized economies have increasingly faced social problems such as changing demographics, unemployment or education deficiencies. Due to limited financial and organizational resources, public sectors struggle with offering solutions to these problems. In the face of those difficulties, the private sector has started to engage in formerly public interest issues and offers innovative and sustainable solutions to social problems. Entrepreneurial activities have been launched to address pressing social needs for which the public sector has failed to provide solutions. The combination of entrepreneurial performance and the tackling of social issues has evolved as a distinct institutional form: social business. Internationally promoted by Nobel peace prize laureate Muhammad Yunus, the concept attracts interest in both developing and industrial countries. Several scientific contributions already put focus on social business or social enterprises as an innovative, socially oriented business (Defourny & Nyssens, 2010; Yunus, Moingeon, & Lehmann-Ortega, 2010).

Methodology

In this paper, we present survey data of expert views on the future development of social business in an industrialized country. Germany is already subject of other scientific contributions regarding the broad field of social business, mainly based on case studies (Achleitner, 2007). With this research, we aim to structure expert knowledge and deepen the understanding of uncertain future events regarding social business in Germany. Thereby, we focus on environmental conditions like legal, social and institutional surroundings and long-term consequences of social businesses to provide solutions for social needs in an industrialized country, which is inline with Klein, Mahoney, McGahan, & Pitelis (2010). We conducted a Delphi survey, which has – over the past decades – proven to be a profound technique for foresight and scientific long-term analysis, such as scenario analysis (Landeta, 2006). We composed a panel of 68 experts from academia, for-profit companies, NGOs and social entrepreneurs in order to capture a broad and differentiated perspective of the future of social business in Germany. Furthermore, our results were used to develop extreme scenarios

for the establishment of social businesses in Germany in order to gain a better understanding of the concept's future.

Results and policy impact/implications

This most recent survey gives insights into the future potential of social businesses as an innovative institutional technology in addressing continuous societal changes in industrial countries. Results include the expected probability, impact on the German economy and the occurrence desirability for 16 propositions. Furthermore, the analysis includes a strategic map for the probable and desirable future of social business and extreme scenarios. Following the 1,212 arguments posted during the survey, experts see the development of social business accompanied by a "change in the social value system" which underlines our assumption in the multi-stakeholder discussion that social business will contribute to societal change to a certain extent. Furthermore, we developed four extreme scenarios based on the Delphi results: "The Social Guardian", "Social Paradise", "The Social Fallow" and "Social Capitalism". Implications for policy makers are the need of a special legal status of social businesses, standardized governance structures and inclusion into education and research programmes. This might provide the framework for social businesses to prosper in Germany and are likely to enable them to address societal change, where established approaches do not contribute to social solutions. The extreme scenarios allow political decision makers as well as social business managers and entrepreneurs to consider and evaluate different possible futures and prepare them to act accordingly.

Conclusions

With this paper, we offer insights for further discussion and research on social business and its potential influence on society by including a broad range of factors on the competitiveness and the potential of social business as a business concept. The scenarios provide complex pictures that display a range of considerations and possibilities of how and to what scale social business may establish (Masini & Vasquez, 2000). As the German case can be taken as a model for problems many European countries are facing, our findings can be employed as a starting point for bringing the social business innovation to a strengthened and contextualized academic debate. Further research venues could cover pathways to develop social business to an institutional technology in European countries.

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UNCERTAINTY, FORESIGHT AND STRATEGIC DECISION MAKING: EVIDENCE FROM LEADING COMPANIES

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Keywords: Environmental uncertainty; decision making; foresight practices and techniques; planning; learning.

Introduction

The strategic management literature and the organization theory literature have long emphasized the role of the environment as a major source of uncertainty for strategic decision makers in charge of coping with emerging opportunities and threats.

A broad range of heuristic approaches for carrying out future studies have been developed in corporate organizations with the aim of promptly selecting drivers of change in the company's outside environment (environmental scanning) and of investigating their likely evolution and impact on the organization (future-oriented techniques). Today the term 'foresight' is widely used to designate the activities and processes that assist decision makers in the task of charting the company's future course of action by encompassing either scanning or future-oriented techniques.

So far, foresight has achieved uneven success and popularity. Some skepticism arose in the academic community regarding the soundness and appropriateness of foresight for making predictions about the future and, thus, for supporting predictive strategies. The major evidence of this skepticism may be the fact that today it is not specifically addressed by most MBA curricula and so far only a limited number of validated analyses of future studies have been hosted by leading academic journals.

Supporting scholars and practitioners generally respond to concern about the reliability of foresight by arguing that its role is not so much to predict the future, but to prepare the firm for the future through a learning process. Still, the following questions remain largely unexplored: what different kinds of uncertainty (drivers of change) may be faced in the business environment? how should a firm design the right foresight approach, i.e. what type of techniques and practices should be adopted in different business environments and thus in the face of different kinds of

uncertainty?

These are precisely the main questions we deal with in this paper. Their relevance is extremely high because deciding what firms should do next in uncertain situations is a key issue in the literature on strategic management, and at the center of the debate between the *planning* and the *learning* schools.

Methodology

In order to explore the relationships between environmental uncertainty, foresight, and strategic decision making we performed a multiple case study of corporate organizations. In this paper we focus on major companies that operate in the chemical industry, the automotive industry, consumer electronics, and the ICT sector.

Results and policy impact/implications

First, we expand our understanding of environmental uncertainty by defining the concept of 'boundary uncertainty'. Boundary uncertainty involves the identity of the main components of the business microenvironment (i.e., rivals, suppliers, customers, substitute products, potential entrants), the activities of their value chain, and the mechanisms – business models - through which they try to create and capture value.

With the concept of boundary uncertainty as a backdrop, we distinguish between two main kinds of drivers of change. The first one is '*continuous*' drivers of change that support and enhance the traditional identity of the main components of the business microenvironment, leading to incremental developments in the value chain and the business models of established firms, and thus in their main kinds of activities and products. Such drivers are typical of mature global industries where trajectories of technologies and customer needs are well-established and companies compete for market share at the international level. The second one is '*discontinuous*' drivers of change that have disruptive effects on the business models of established firms and lead to completely new kinds of products, players and activities in the value chain. Such drivers are typical of emerging industries and more generally of industries where technology is the main driving force and new customer needs rise to the fore.

We shed light on the implications of boundary uncertainty for foresight and strategic decision making, and advance a conceptual framework of foresight efforts and practices as a contingent methodological and organizational approach.

Conclusions

Our work relates to several fields of research in strategy and organization. First, it improves our understanding of the different kinds of uncertainty and drivers of change that a firm may face in the business environment. Second, it provides empirical evidence on the ways foresight activities of large organizations might be integrated and how the results might be used to support strategic decision making. In particular, it provides the broad outline of a conceptual framework

about how to cope with different kinds of uncertainty (boundary, state, effect, and response uncertainty) through different methodological and organizational approaches. In this way, we try to enhance the academic standing of foresight and its use by practitioners: matching the right foresight approach with the specific kind of uncertainty faced by the firm is an essential condition in order to foster and nurture the learning process about the future which scholars and practitioners in the field have suggested as the main contribution of foresight to strategic decision making.

FTA CAPACITY BUILDING IN A BROAD SENSE: FTA TO CHANGE PREVAILING ATTITUDES AND ORGANISATIONAL SETTINGS THAT PREVENT PARTICIPATORY STRATEGY-SETTING PROCESSES

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Keywords: national innovation systems (NIS); policy governance sub-systems (PGS); the prospects for, and role of, FTA in changing attitudes and organisational settings.

Introduction

There are even stronger needs for strategic thinking in Central and Eastern European countries and the so-called Newly Independent States (former Soviet Republics) [CEE/NIS] than in the advanced countries, given their specific challenges, in particular their fundamental political and socio-economic transition processes, as well as major changes in their external environment. Yet, long-term thinking is discredited across the region. Moreover, several of these countries only exist as sovereign entities only for 20 years, and hence thinking ahead of 20-25 years is almost beyond the imagination of decision-makers. The presentation illustrates this general phenomenon with the example of science, technology and innovation (STI) policies.

Methodology

The discussion of these issues are based on the author's personal experience with several foresight programmes, interactions with policy-makers in the region, analysed through the lens of evolutionary economics of innovation. As a background, stylised facts of the national innovation systems in the CEE/NIS regions are also considered, as well as the main features of strategy-setting processes, characterising the policy governance sub-systems (PGSs). The major dimensions to describe an actual PGS include: oligopolistic *vs.* distributed structure; degree and type of legitimisation (process and/or output legitimacy); systematic *vs.* sparse, ad hoc use of policy preparation tools (PPTs).

Results and policy impact/ implications

Policy-makers in the CEE/NIS region do not rely on modern decision-preparatory tools to a sufficient extent, and quite often do not realise the close interconnections between research,

technological development and innovation (RTDI) processes and socio-economic development. Thus, in many cases, they are only willing to support RTDI when they can "afford" – although it should be the other way around: "we spend on promoting RTDI processes, because we want to foster wealth creation". STI policies are isolated from each other, and major economic policies are not co-ordinated with STI policies.

FTA activities, especially foresight (given its participatory nature) may change these attitudes, but exactly because of the above factors, "genuine" ("fully-fledged") foresight processes are rare in the region. One cannot observe strong commitment for profound foresight processes, that is, serious consideration and determined implementation of policy recommendations, introducing a new decision-making culture, along with a new way of thinking, with more emphasis on communication, co-operation, and generating consensus among the major stakeholders, and commitments to take joint – or, at least orchestrated – action, based on shared visions.

Conclusions

The main conclusion of the presentation is that building FTA capacities for structural transformations in emerging economies should be understood in a broader sense than in advanced countries, which can rely on deeply embedded strategic intelligence sub-systems. Besides developing professional competences of FTA practitioners – both in the form of specialised, 'external' FTA service providers and internal FTA units located at policy-making bodies or large businesses – creating (or in some cases: strengthening) 'absorptive' capacities of politicians and policy-makers, as well as raising awareness among stakeholders is also of crucial importance. That sort of capacity building is needed to launch FTA activities in the first place, and then 'translate' FTA results into policies, which are systematically implemented.

Advantages and drawbacks of centralised and distributed forms of institutionalising FTA activities in CEE/NIS need to be considered in this broader sense, and actions are to be devised accordingly.

International co-operation, in particular when assisted by international FTA networks, can raise awareness among policy-makers and other stakeholders, and also enhance the chances of success by sharing lessons, easing the lack of financial and intellectual resources through exploiting synergies and economies of scale. It is crucial, however, to maintain the commitment of local actors, e.g. in terms of time and funds devoted to foresight, and willingness to implement the results. In other words, the main forms of foreign assistance should be the provision of knowledge-sharing platforms and other fora to exchange experience (among emerging economies, as well as with advanced countries), monitoring and evaluating foresight initiatives in the CEE/NIS region.

Some of the lessons from the CEE/NIS region can be extended to other emerging economies, too, especially the importance of a broad understanding of the needs with regard to FTA capacity building.

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ERAWATCH and TrendChart country reports

ForWiki-A Tool for Building Foresight Capabilities in Enterprise 2.0 Driven Organisations

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Abstract

An Enterprise 2.0 driven organization uses emergent social software platforms (such as wikis, blogs, prediction markets, Facebook or Twitter) within and between organizations, developing new capabilities and producing powerful results. The concept of Enterprise 2.0 is a truly disruptive innovation, designating an emergent and self-organizing network of relationships which enables executives to digitize and monetize collaboration. E2.0's organizational and technology constructs represent a new approach toward satisfying goals for growth and innovation, where the hope is that an open exchange of ideas will support business value and personal development. E2.0's are highly connected and agile organizations, sensitive in respect to societal trends, concerns and needs, while still willing to create Foresighting abilities. The paper identifies key concepts employed in building the Foresight Wiki - a learning support infrastructure designed with the specific goal of developing Foresight capabilities in Enterprise 2.0 driven organizations – and states several implications for the platform's structure and organization. The Foresight Wiki (or FORwiki) is the Web 2.0 version of the FOR-LEARN Online Foresight Guide, inscribed within the connectionist paradigm of eLearning 2.0. Moving beyond cognitivist or constructivist approaches, eLearning 2.0 relies on a self-organizing process which requires that the system is informationally open and capable of changing its structure. FORwiki offers a platform for creating communities of shared meanings (in Bakhtinian sense) on fundamental concepts of Foresight, as well as practices of Foresight. The platform's content is open-ended, while the communities' discourse rests in continuous transformation. The paper uses discourse analysis techniques in order to systematically explore often opaque relationships of causality between discursive practices and wider social-cultural structures within the larger Foresight community of practice. The analysis takes place at two levels: microstructure and macrostructure. At the microstructure level, the analysis is focused on the semantic relations between the discourse's elements, including the rhetorical elements. At a macrostructure level, the analysis is directed at the thematic/topic structure of stories about Foresight exercises, and overall understandings of Foresight. The conclusion supported by the authors is that Enterprise 2.0 driven organizations will trend to connect Foresight units in socio-cognitive spaces of innovation, creating thus networked structures of FTA.

Research and Technology Organisation: Applying Diversified Roadmap Concept at VTT, Finland

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Keywords: systemic transformation, capacity, research and technology organisation (RTO), anticipatory culture, roadmapping, diversified roadmaps, strategy process.

Introduction

Currently the different organisational and geographical scales of innovation systems are more interlinked than ever. It means that ramifications of developments and systemic transformations flow through this meta-system faster than before and these flows have complex effects. Because of this systemic complexity, the implications are also harder to anticipate. This is why research and technology organisations (RTOs), as key nodes in the meta-system, should develop at least two systemic capacities: 1) partial structural openness and fluidity that endorse rapid alterations in the organisational structures enabling flexibility in responding to the systemic flows, and 2) horizontal and pervasive anticipatory culture that in a networked fashion integrates the critical knowledge in a RTO to reflexively construct its future 'mission' and internal future-oriented agency, i.e. proactive and bottom-up participatory approach which leads to action.

Methodology

In this paper we explore the questions of systemic transformations and the building of anticipatory culture in the context of a Finnish RTO, namely VTT Technical Research Centre of Finland. Firstly, we discuss VTT's internal R&D approach that emphasises the so-called parallel innovation process. In the present model, the function of foresight is to be the first step when entering this process. We suggest a change in this thinking by transforming the foresight into a horizontal organisational function that permeates all levels of the parallel innovation process. Secondly, we propose that principles of technology roadmapping could be applied in building the two above mentioned strategic capacities and constructing the horizontal foresight function inside a RTO.

We present a diversified roadmap concept that adapts the basic principles of traditional technology roadmapping and widens its horizon towards such directions as visionary strategic management, network building and development, and organisational learning and adaptation.

Thirdly, we exemplify these diversified roadmapping concepts by analysing two VTT case studies: Sercive Science Business (SSB) Network roadmapping process and Building Service roadmapping process. The case studies have two aims: 1) to present and assess the diversified roadmap method and 2) to evaluate roadmapping as a catalyst of systemic changes in a RTO.

Results and policy impact/implications

The case studies will reflect on the questions of how to build a required level of systemic openness and stimulate the construction of horizontal anticipatory culture in a RTO. Thus our results will be threefold: Firstly, the paper provides paths to enable anticipatory culture in RTOs and other organisations. Secondly, the paper widens the scope of roadmapping towards the field of organisational development and visionary planning. Thirdly, the paper presents a diversified roadmap model that can be applied in specific organisational settings. The key issue from the policy perspective is that the generic ideas of this paper can be utilised also in several policy fields.

Conclusions

Constructing systemic transformation capacities in organisations requires challenging organisational capacities: the capacity for structural openness and capacity for anticipatory culture. These capacities are dependent on the organisational tradition - this is why it is important to realise that foresight sensibility also requires contextual historical understanding.

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EVALUATING LOCAL PUBLIC FORESIGHT STUDIES FROM A USER PERSPECTIVE

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Keywords: foresight, user perspective, strategic policy-making.

Introduction

This paper deals with the opinions and experiences of local Dutch and Belgian policymakers in applying foresight methods in the context of strategic policy processes. The added value of foresight methods will be described in light of the different goals and intentions employed when opting for different foresight methods. For this, a distinction will be made between different phases of the policy cycle, i.e., agenda-setting, policy preparation, decision-making, implementation, and evaluation. Special attention will be paid to factors, levers, and barriers commonly perceived to be of influence to the added value of foresight methods.

In most evaluative studies on foresight the added value has been addressed from a *supply driven* point of view. With supply, we mean the producers of studies of the future, that is, the futures researchers. In this paper, however, evaluation will take place from a *demand driven* perspective. In other words, the user perspective – i.e. that of policymakers who have applied foresight methods such as scenario analysis in policymaking – will take centre stage. We will contextualise our findings on a local level further by relating them to results from studies focussing on the national level.

Methodology

The insights presented in this paper are based on recent policy document analyses, in depth interviews, and questionnaire research with users in the policy domain which have been conducted to build empirical evidence. Policymakers have been asked to reflect upon how they perceived the use of foresight methods. In our research, we focussed on policymakers working in local governmental organisations who made use of future exploration methods for the first time on the one hand, or had an experience of some years with applying foresight methods on the other hand.

Results

The added value of using the foresight method as experienced by policymakers on a local level, manifests itself in process-related and content-related forms of impact with an emphasis on process-related forms of impact. Policymakers indicated, for example, that they perceived the cross-sectoral way of working as one of the main process-related benefits of using foresight methods gained. It appears that a cross-sectoral way of working is unlikely to be taken for granted within a governmental organisation. Furthermore, foresight exercises have been experienced as mutual learning processes, allowing participants (i.e. policymakers) to gain a better understanding of each other's perspectives on the future, thereby laying a common basis for developing policies.

Content-related benefits have also been indicated. Policymakers indicated that foresight methods stimulate them to take future developments and changes into account in a *structured* way. When foresight methods are not used and strategic policies need to be developed, future-related assumptions are made in an intuitive and rather opaque way. Consequently, all too often they are merely based on personal assumptions. Through the use of more systematic (foresight) methods, policymakers are forced to be transparent and explicit about assumptions underlying their policies and to consider all relevant factors or developments. Foresight methods are felt to stimulate the user to develop strategic policies in a more *rational* way. Foresight exercises brought new insights to the fore, new perspectives on societal issues, mainly in terms of raising awareness. Finally, policymakers indicated that foresight methods have been used in a suboptimal fashion. In retrospect, they felt that insights of studies of the future could find a better embedding and stronger interweaving with ongoing processes of policy development.

Conclusions

In the retrospective scans it has been explored why foresight methods are being used in a suboptimal fashion by exploring which levers and barriers were encountered by policymakers who were involved in the in-depth interviews. The experiences learn that the success of a future study as experienced by users mainly depends on process-related and organisational internal levers and barriers. Factors such as the timing of a future analysis in a strategic policy process, leadership and trust, and governmental commitment of the study came to the fore. Also, the embedding and securing of the body of thought related to future thinking and acting was encountered as a relevant success factor. Furthermore, the availability of knowledge in the organisation with regard to foresight methods, sources of future related information and the skills for developing and using future studies, is a crucial factor for the success of the use of foresight methods. When we compare the findings on a local level with findings from a study focused on the use of foresight on a national level (Van der Duin, Van Oirschot, Kotey & Vreeling, 2009) we see, for instance, that on a national level the political dimension of high importance (e.g., the personal beliefs and demands of a Secretary or Minister can be of great influence on the type and use of study of the future), that the level of expertise with regard to foresight is often higher, and that thinking and acting integrally is easier for governmental officials on a national level.

The experiences highlighted in this paper illustrate that it is not self-evident for local governmental organisations to use future methods in an optimal way. The analysis illustrates that when a governmental organisation decides to use foresight methods, they experience it as a big step, often even a step of transformation of the organisational culture, a new way of thinking and acting throughout the organisation. Routines in strategic policy processes do not always match with the characteristics of foresight methods.

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EVALUATING FUTURE TECHNOLOGY ASSESSMENT – CANADIAN CASE STUDY

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Keywords: Evaluating technology assessment, technical intelligence.

Introduction

The National Research Council (Canada) established a cross Canada unit whose job was to provide Future Oriented Technology Assessment to assist with government technology policies and funding programs. While termed a CTI (competitive technical intelligence) unit, the methodology and subject matter clearly is technology assessment and the analytical techniques are consistent with those found in the FTA literature. Similar to many such organizations around the world (for example Forfas and UK Foresight office), the projects addressed by the unit cover short, medium and long term orientations and range from simple patent reviews to complex foresight methods. The overall objective of the study was to develop a methodology that could be used to assess the performance of organizations engaged in future oriented technology assistance. Fitting with current definitions of foresight found in EFMN, the focus of this unit was to develop shared long term visions which would be used to assist with shorter term decisions.

Methodology

To identify how the process could be evaluated, the researcher conducted a literature review on foresight benefits and evaluation, consulting, library and competitive intelligence. The review led to the development of a preliminary evaluation model and an interview guide to be used on the unit's clients as means of assessing the technology assessments impact and how they felt it could be measured. Five of the organizations offices were selected for interviews. The study authors then selected the clients they wanted to talk too based on which clients had used the most projects as they would be most familiar with the technology assessment benefits – in a sense an expert group. In all interviews were held with 15 clients. After each set of interviews, the clients where then sent an updated list of technology assessment benefits. This list was modified based on the input from each of the interviews. The modified questionnaire was then brought to the next office and the same process was used. The final revised questionnaire was then sent to all the participants in the study for a final revision. Clients were asked to indicate if the list accurately reflected the benefits they had received and if other benefits had arisen that were not indicated on the list.

Results and policy impact/implications

Consistent with past literature participants indicated that financial and other hard measures would be difficult, if not impossible to do. The only measure that could be used would be a perceptual measure (subjective questions about whether the client had received the benefit). The reason for this lay with the complexity of the client decision making process and also the existence of significant amount of indirect benefits. For example a technology assessment used for policy development was also integrated in a speech the client made to an industry association and an interview conducted with a national news network that resulted in the assessment being used by many other companies and government agencies. The indirect benefit would be very difficult to measure. Based on the comprehensive literature review and discussions with the client as well as senior organizational personnel two models were developed, one for evaluating the service and the other for identifying critical success factors involved in getting impactful technology assessment. In terms of the evaluation model, six areas of performance measurement were identified with measures suggested for each: 1) Organization performance: How well is he organization doing in their FTA program? How well is it developing (this is a general area of measurement for the entire organization) and can include productivity measures, efficiency measures and so forth   2) Individual performance: Are the FTA officers doing their job well. There are standard skills sets that have been identified with foresight – to what extent do the individuals possess these skills? 3) Project/process performance: Is the FTA process being conducted appropriately. Both foresight and intelligence have well developed methodologies that need to be followed for proper projects to be conducted. In intelligence for example, there are planning, gathering, assessment, communication and management methodologies that can be examined. In an assessment of their unit, a well known CTI expert examined NRC CTI project plans and assessed whether he would have conducted the project in the same way. 4) Output performance: What is the quality of the intelligence output itself. This is more standard consulting type measures such as quality of the materials, client satisfaction, word of mouth support by the client groups etc. 5) Impact performance: What direct and intended impact did the technology assessment have. Foresight is supposed to lead to actionable decisions, did this arise? The study found dozens of foresight and CTI impacts that can be measured. 6) Secondary impact performance: What indirect unanticipated impacts arose from the FTA reports. This is similar to #5 and recognizes that the foresight study can have impact well beyond the initial intent of the project. For example, other stakeholders may read the report, relationships can be established that are used in subsequent projects. Finally, in the area of predicting technology assessment success, the model developed suggests that providing project guidelines are followed and officers have the appropriate skills, the major predicted of success lies with the client themselves and their knowledge and receptivity for technology assessment recommendations.

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EXPLORING THE IMPACT OF FLA ON NATIONAL INNOVATION SYSTEMS

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Keywords: Forward-Looking Activities (FLAs); policy governance sub-systems (PGS); national innovation systems (NIS); fit between a chosen FLA approach, the perceived policy needs/ opportunities, and the PGS; impacts of FLA.

Introduction

In spite of several decades of using Forward-Looking Activities (FLAs) in the context of science, technology and innovation (STI) policies, our knowledge of the actual impacts of FLAs on national innovation systems (NIS) is still very limited and based on case-by-case evidence – mainly evaluation reports or case descriptions – rather than systematic comparative analyses.

One of the reasons for this knowledge gap can be found in the great diversity of FLA in methodological terms. What further stresses the challenge of anticipation is that the "objects" to which FLAs are applied are complex in nature. This is reflected in the innovation system (IS) approach that has come to dominate our current thinking about STI policies and system performance.

For the purpose of investigating impacts of FLAs on ISs, the conventional actor-centred IS approach shows a number of limitations, particularly with regard to governance cultures. Looking into complementary lines of reasoning for better capturing possible impact chains is thus a potentially fruitful inroad to follow. Against this background this paper offers an analytical framework to study the impacts of different types of FLAs on different types of innovation systems and in particular their sub-systems of governance. The applicability of this framework will be illustrated by comparing actual cases.

Methodology

The paper relies on various theoretical building blocks of evolutionary economics of innovation, as well as on political sciences, most notably on the policy governance literature. While we believe that our approach can be extended beyond national ISs (e.g. sectoral, regional, etc.), we concentrate on the national level in order to limit the complexity of our analyses.

First we develop a tentative typology of FLAs, covering different dimensions such as rationale (reinforce the existing NIS and/ or its sub-systems vs. transform it/ them); degree and types of participation; as well as its relation to other policy preparation tools (stand alone vs. embedded).

Second, we deepen the national innovation systems perspective, by zooming into the change processes, especially at the level of policy governance sub-systems (PGSs). We apply four dimensions to characterise an actual PGS: oligopolistic –distributed structure; antagonistic– consensual strategy setting processes; degree and type of legitimisation (process and/or output legitimacy); systematic vs. sparse, ad hoc use of policy preparation tools (PPTs).

Results and policy impact/ implications

Our framework contributes to identifying which types of FLAs are suitable under which circumstances. The combination of a typology of FLAs and a focussed view on national innovation systems in characterising PGSs provides us with an analytical framework to systematically compare specific NIS-centred FLAs and their impacts. We will refer to different countries in order to illustrate the relevance of our framework. These countries are rather diverse on purpose, and include Columbia, France, Germany, Hungary, Japan, and Romania. The application of our framework leads to two strands of observations: First, observations are made that refer to the internal correlations between the different dimensions of FLAs (e.g. between its rationale and the degree of participation) and PGS (e.g. between consensual/antagonistic and systematic/sparse use of PPTs). Secondly, we develop observations how different dimensions of FLAs correlate with different dimensions of PGS (e.g. between oligopolistic/distributed PGS and rationale of FLA).

Conclusions

This type of analysis, applied thoroughly and honestly, will lead to well-substantiated policy conclusions on the appropriateness of different types of FLAs for different kinds of governance cultures, and for improving certain "functions" of innovation systems by way of FLAs. The major question is the fit between a chosen FLA, the perceived policy needs/ opportunities, and the policy governance sub-system. The closer the fit, the higher/ more favourable impacts of FLAs can be expected (assuming an appropriate quality and methodological rigour of conducting FLAs). Yet, it would be a mistake to presuppose linear (sequential) links among these "elements" of a needed fit, as they interact in several ways. First, an often neglected impact of FLAs is that the understanding of the originally targeted policy needs/ options would need to be revised, and new policy needs/ options are likely to be identified. Second, FLAs would impact on the policy governance sub-system itself: a non-participatory FLA would reinforce the "closeness" of a PGS (its reliance on expert-based approaches), while a participatory FLA would open up a "closed", hierarchical PGS in a longer run, and with ensuing tensions, of course. Analysts and decision-makers also need to ask themselves a broader question when a lack of "fit" between the above three elements is observed: is it a mistake in policy design or is it designed on purpose (that is, to run a transformative FLA)?

TOWARDS IMPACTFUL FORESIGHT: ADVISE FROM THE ADVISORS

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Keywords: Foresight success.

Introduction

As the Seville FTA 2011 conference call for papers states, "FTA offers policy and decision makers the potential to look across such transformations, enabling governments and other organizations to become more adaptive and capable of enacting systemic change The authors/ presenters of this paper have combined experience of over 80 years in technology foresight and related areas in academic study, capacity development seminars and project execution. They have seen rapid growth in foresight both within industry and government. For example, today in Canada at the Federal level, several departments have formed foresight units and it has become in many cases a requirement for policy development. Similarly in Canada at the industry level, a foresight program done in Newfoundland and Labrador which brought together some 75% of the industry participants in Oceans Industries including government, industry and academe has already resulted in a doubling of industry sales. At the same time, the authors have witnessed the demise of other foresight units, projects that resulted in no impact, and significant downsizing in foresight resources. Some of these projects have had impact and some that have not. This presentation/paper focuses on providing policy makers, academics, consultants and others involved in foresight key lessons learned for building FTA capacities for systematic and structural transformation . How has and how can FTA provide support to decision making. Through numerous case study reports which the authors have been part of, a panel/paper will be presented which explores: methods for evaluating the effectiveness of FTA (from a recent study of the National Research Council), the role of private sector consultants and other organizations for enhancing, supporting and helping to develop FTA capacity, and a look at some of the organizational forms of FTA that have led to FTA success and failure. In short, the three authors will share their experiences with conference participants on factors important to foresight success. Dr. Calof has been instrumental in several countries Foresight Programs, Dr. Jackson through Shapingtomorrow has one of the largest foresight online advisory services in the world serving both private and public sector foresight programs, and Riel Miller is one of the foremost foresight consultants, serving as a chief adviser to dozens of government agencies.

Results and policy impact/implications

The following provides selected tips from the authors based on past experience.

From Riel Miller:

Understand first of all that the challenge is to "use the future" to think about choices in the present, not to find the future to serve as a target.

Understand second of all that the use of the future is inscribed in an anticipatory system and that you need to think about the nature and attributes, purpose and functioning of the particular anticipatory system that is pertinent to your context.

When conducting an exploratory foresight exercise aimed at embracing complexity refrain from probabilistic and causal logics.

Make sure to pay careful attention to ensuring a congruence between the process and outcomes in the design of the process. Do not forget that in a foresight exercise there is always a key deliverable related to "process as product".

From Michael Jackson:

Shaping tomorrow has devised a test to evaluate foresight current and desired capacity for the development of world class foresight:

Leadership. Helping organizations to translate foresight into action...on an on-going basis.
Framing. Helping the organization identify and solve the right problems.

Scanning. Helping organizations to understand what's going on in its immediate environment and in the world at large.

Forecasting. Helping organizations consider a range of future possibilities.

Visioning. Helping organizations decide what they want in the future.

Planning. Helping people develop plans, people, skills, and processes that support the organization's vision.

Dr. Jackson has found common traits across future thinking, innovative, risk aware organizations including:

Strategically and simultaneously focusing on innovation and risk.

Systematically gathering precursory insight of changes happening in the world around them.

Sensing and adjusting to emerging change.

Collaborating and partnering far beyond traditional commercial boundaries.

Using simple, quick processes to reduce cycle times.

Measuring and rewarding on a few vital organizational-level metrics.

From Jonathan Calof

Providing that those that are running the foresight projects are properly trained and the project is appropriately planed and budgeted, my experience and research has found that foresight success and impact starts with an educated client. Senior decision makers need to understand the role and benefits of foresight, trust those developing it, and be part of a supportive culture. Following this, several critical success factors have been seen in past work including: being client and policy focused and most importantly recognizing the need to make recommendations that are actionable in today's policy time horizon. This last point has been made within several foresight units. This is where the European Commission definition of foresight: "a participative approach to **creating shared long-term visions to inform short-term decision-making** process". To do this requires good understanding and direct links to senior decision makers; clear communications strategy; and strong links with external experts and stakeholders.

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Navigating FTA in a Sea of Expectations

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Keywords: expectations, technology roadmapping, sociology of expectations, policy, foresight

Introduction

This paper conceptually and empirically investigates the phenomenon that socio-technical developments are saturated with formal and informal anticipations and discusses the implications for Future-Oriented Technology Analysis. The central argument is that FTA exercises, as formal articulations of possible futures, are the product of practices that that draw on a broader repertoire of visions and future assessments. Within practices of engineering, strategy formulation and policy making, expectations circulate and are forceful in various ways. Therefore, we should investigate this condition in detail and discuss the implications for the institutionalization of FTA. This paper addresses the theme "Building FTA capacities for systemic and structural transformations" in particular the topics of "embedding of different forms of FTA in the public sector and implementing FTA results into policy and decision making" and "FTA as a source of legitimacy".

Methodology

The paper employs two methods. First, it investigates the relevant literature on expectations to unravel the position of FTA in the 'sea of expectations'. In particular two sets of literature are relevant. First, the sociology of expectations, which investigates how expectations are part and parcel of the practices of science and technology. A second set of literature and experience is the tradition of technological road mapping, which is more design oriented. It has its roots in studies of business strategies, but the last decade it is increasingly popular amongst governments as well. The idea is to seek creative linkages between technological skills, sequences of products and foreseen markets.

The second method is a review of two cases from the Dutch context of FTA practices, one within the Ministry of Environment (2002-2007) and one within a semi-public nanotechnology consortium, NanoNed (2005-2010). I will describe how the FTA researchers were recruited, how their activities were embedded in ongoing processes of anticipation and how the results of the FTA exercise derive their significance from the set of informal expectations.

Results and policy impact/implications

From the literature review I conclude that researchers, firms and governments have to operate in an environment in which expectations about technical possibilities, markets and societal developments abundantly circulate. The literature describes how collective expectations urge the stakeholders to act and to position their strategies. Since actors are aware of this situation –that is, they are reflexive– strategic games occur that may lead to self-fulfilling or self-negating prophecies.

FTA exercises will inevitably draw on collective expectations and this sets cognitive limits to the content of the produced futures as well as limits to the political efficacy of FTA as an instrument. From the two empirical studies I conclude that the limits are to be found in the pertinent (i) images, (ii) concepts, and (iii) causal chains that colonize the interactions between FTA practitioners and their environment. In return, the condition of FTA in the sea of expectations enhances the viability of FTA exercises.

Conclusions

I conclude the paper with a reflection on the implications for the practice and institutionalization of FTA. The ongoing circulation of informal assessments enables and constrains the possibilities of FTA exercises in a particular way. To enhance the alignment of formal and informal expectations makes FTA socially more robust, but cognitively more vulnerable. How can it raise salience and how does it hamper its efficacy? A fruitful way to make use of the condition of ongoing anticipation is to make this condition more explicit, while not forgetting the political aim of the exercise. In other words: in order to navigate FTA in the sea of expectations we need both clear sight on the sea as well as a compass.

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The Challenges of Communicating the Foresight Study Outcomes to Better Advise Decision Makers in Policy and Strategy Matters

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Keywords: Foresight; Decision-making; Strategic intelligence; Communication; Mindset transformation.

Introduction

This paper addresses the challenges of communicating the results of foresight processes to decision makers in a way that truly supports their decisions with confidence and credibility. There are several difficulties often embedded in foresight recommendations regarding the relations between a particular innovation system and the complex and uncertain world. The knowledge about the whole line of reasoning of those in power to shape decisions and the quality of the information that supports these are critical to enable change and positive impact. Therefore, a foresight practitioner must be prepared to design foresight exercises with macro processes of collective intelligence that are able to involve their clients from beginning to end of the overall process, taking care to clarify and bring into the light existing bias and, on the other hand, to promote commitment. This consideration has been in the backbone of the Center for Strategic Studies and Management (CGEE), which has been acquired through more than 400 foresight studies developed over the course of the past 9 years. The methodological approach employed by CGEE in this regard contains some vital elements.

Methodology

First of all, stakeholders must be involved in a foresight exercise from the very beginning. They have to feel comfortable and self-confident regarding the foresight exercise and its subsequent recommendation. This specific part is associated to definition of main objectives. Usually, at this point, CGEE's purpose is to hear, interpret and comprehend the client's necessities, desires and worries. CGEE's task in this context is to help to describe the main objectives and strategic goals

taking into consideration several possibilities, opportunities and different perspectives to foresee the client's preliminary intentions and then suggest some proposals. The second remarkable characteristic of CGEE's Methodological Approach of introducing collective intelligence processes is foresight exercise planning. This activity deals with the design of the foresight exercise trying to show, in an anticipatory manner, the whole process and the most important points that have potential to introduce innovation and what requires mind-set revisions.

Results and policy impact/implications

As a result, the paper presents CGEE's lessons learned in this period and its relation to improved support to policy options and their implications To this end, the case study developed for FINEP's strategic foresight - the Brazilian Innovation Agency - will be discussed. The main objective was to support the configuration of a new management model for the agency that would assure, for the next fifteen years, its position as the main public funding and promotion agency and inductor of national development based on innovation. The methodological approach used by CGEE assured, through the participatory process, the commitment of an expressive contingent of internal and external stakeholders, not only with the process, but also – and mainly – with its continuity.

Conclusions

This paper is concluded by means of exemplifications in three types of decision makers from: government; corporate; and academia. These groups differ in the following aspects:

- Preparation and delivery timing vary substantially among government, corporate and academia clients: It is important to be aware and respect their timing.

- Foresight exercises are usually exposed to some dangerous traps or milestones along their applications. In order to avoid these situations, it is important to note some characteristics related to each group:

  o Government representatives frequently start making decisions before interpreting what was obtained in the first phase (information and data gathering), as discussed before.

  o Corporate executives may have difficulties thinking beyond their business. Foresight exercises and innovation strategies are interconnected and it is important to stress the possible influence and impacts from other business segments.

  o Academia often has difficulties thinking beyond disciplinary structures. Due to a long disciplinary tradition of research and learning in the academic world, when foresight exercises and innovation strategies are applied to new future possibilities in academia, they demand huge efforts of mindset revision and transformation.

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FORESIGHT AS AN INNOVATION POLICY TOOL IN SMALLER CATCHING-UP ECONOMIES: GRAND NARRATIVES OR INTELLIGENT PIGGYBACKING?

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Keywords: foresight, small economies, catching-up economies, techno-economic paradigms, ICT

Introduction

Following the example of Western Europe and many other developed economies, the 2000s saw a rise in the popularity of foresight practices in the smaller catching-up economies of Central and Eastern Europe. However, these foresight exercises have not always had an impact on actual policy processes.

The paper raises several methodological issues related to foresight practices in smaller catching-up countries. Two case studies are used to examine the role and impact of recent technology foresight exercises on Estonia's public policy and to draw lessons from them: (1) the pilot foresight action in the fields of ICTs, biotechnology and nanotechnology within the EU FP6 eForesee project (Tiits *et al* 2005) and (2) the more recent EST_IT@2018 foresight exercise undertaken by the Estonian Development Fund (Tiits & Rebane 2009).

Methodological issues

Recent foresight literature and practice has treated all economies as largely the same, and has focussed mainly on different foresight methodologies and on the results. Contrastingly, economics literature distinguishes between advanced economies that operate at the cutting edge of the development of new technologies, and catching-up economies that are still striving to reach the technological and living standards of the advanced economies. This means, however, that sources of technological learning, innovation and economic development are very different in these two groups of economies. Furthermore, the smallness of an economy adds an extra layer of innovation-related complexities in the current globalised world (Kattel *et al* 2010).

Recent technology foresight activities in Europe have built on an approach that can be termed 'Grand Narrative' - foresight exercises, which aim at defining the possible future development scenarios or trajectories at the cutting edge of a given field of technology. While this approach

is a reasonable choice for major industrialized economies, its feasibility for smaller catching-up economies is questionable.

We argue that the smaller catching up economies should opt instead for an 'Intelligent Piggybacking' approach to foresight. It is an approach that acknowledges that:

- the future key technology trends are set by major advanced economies, and it is not feasible for the smaller catching-up economies to influence these;

- the future growth in market demand is likely to occur in specific areas where there are major socio-economic challenges both domestically and globally.

In other words, the central foresight question for smaller catching-up economies should not be "What are the key technology areas for indigenous technology development", but rather "How to restructure and upgrade the existing technological and production capabilities, so that the country will be able to adopt the latest (imported) technologies in producing high-value-added exportable goods and services."

Accordingly, for the successful adoption of the Intelligent Piggybacking approach, it is important to have a good understanding of the scientific and technological capabilities of the particular country. It is also important to have a good command of the main externally defined science and technology trends, and of the country's position in the global production/innovation networks and trade.

Results and implications

In the eForesee project a major effort was made to map the R&D priorities of the major advanced economies in the fields of ICTs, bio- and nanotechnologies. An important conclusion that emerged was that proper understanding of the economic cycles and techno-economic paradigms can actually serve as very useful guidance in the foresight and the elaboration of policy strategies. As part of Intelligent Piggybacking foresight, the sources of Estonia's recent economic growth were determined at the level of specific industries. Building on this, as well as on the historically successful catching-up experiences of Finland, Ireland, East Asia and elsewhere, three distinctly different policy scenarios were devised, which discussed technology trends, industry life cycles, flows in foreign direct investments, global market dynamics and the likely relocation of various industries in time (Tiits *et al* 2005).

The subsequent EST_IT@2018 took note of the fact that the on-going ICT paradigm continues to be an extremely powerful driver for productivity growth. Accordingly, in this work, specific priorities were defined for: (1) the advancement of scientific and technological capabilities, so that Estonia could command the latest ICTs developed in the major advanced countries and (2) the development of new ICT-based products and services in the specific domains where major socio-economic challenges were detected and, in connection with this, also significant growth in market demand was expected elsewhere.

Conclusions

Failures in the transfer of policies from one country to another are widely acknowledged. Similar failures can also occur in the transfer of policy intelligence and policy making tools, such as foresight. Therefore, critical assessment of the context and the adaption of the methodology toolbox are very necessary.

The key lesson from the two recent foresight exercises in Estonia is that the traditional approaches to technology foresight, which are typically employed in larger advanced economies, are not applicable to smaller catching-up economies. We argue that the Intelligent Piggybacking approach is much more suitable for those countries than the traditional Grand Narratives approach. The reason for this is that the smaller catching-up economies rely extensively both on imported technologies and on export markets. This is why the foresight exercises carried out in such smaller countries need to be carried out as truly international efforts that secure an access to the state-of-the-art in frontier R&D, and to the latest strategic thinking in the relevant global production networks.

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THEME 3:
PREMISES AND PRACTICES IN COMBINING QUANTITATIVE AND QUALITATIVE FTA METHODS

THEME 3

PREMISES AND PRACTICES IN COMBINING QUANTITATIVE AND QUALITATIVE FTA METHODS

The range of different methods and techniques that are applied in the field of FTA keeps growing. This offers an opportunity for more tailored design of approaches and techniques to fit the context and purpose of specific endeavours, thus benefiting from each method's particular strengths. In particular, the combination of qualitative and quantitative methods has the potential to produce rounded results, thereby offering policy and other decision makers' robust information on which they can base their strategies and decisions.

The development and application of creative combinations of qualitative and quantitative FTA methods is complex, and requires a good understanding of the epistemological principles behind each approach and methodological school, its context, units of analysis and processes. Until today the communities associated with each of these schools – foresight / forecasting / technology assessment / futures communities – are perceived as different worlds that are competing rather than collaborating in looking at the future and trying to understand the present. An optimal integration of methodologies therefore requires solid theoretical premises as well as appropriate and ethical practice leading to congruent and valid results and winning the trust of the users and other stakeholders of FTA.

It is also relevant to identify and make explicit existing good practices which link the growing need for participation in decision making with the increasing policy demand for evidence-based options and their expected impacts. Assessing FTA studies on how they fulfil this demand will also require new ways of evaluating FTA that implement new combinations of techniques, and that build trust through inclusiveness and transparency.

The combined use of qualitative and quantitative methods can rely on the specialisation and shortcomings of different methods/tools within the same FTA exercise. In participatory methods the scientific quality and validity of outcomes is still an issue. In addition, the exclusive use of such methods can lead to partial views on possible futures, e.g. when relying on qualitative scenarios in devising technology roadmaps. Quantitative models in turn tend to be challenged to demonstrate their reliability in terms of data treatment and outcomes. Beyond a certain time horizon, they tend to lose robustness whereas narrative storylines start to present a higher credibility. There is an increasing awareness of the need to avoid the risk of partial use or misuse of available tools. A critical element in the combined use of such methods is the nature of the interfaces between them, and how these relate to the complementary and contradictory aspects of the methods used.

Ultimately, for what concerns the selection of the most appropriate combination of methods and tools when initiating a given FTA exercise, it is often agreed that no optimal, one-size-fits-all

recipe is applicable. Rather, the choice must take into account context-dependent criteria and methods that can deal with information of all sorts.

Hence, scientific contributions are sought in the form of papers and practical contributions in the form of posters highlighting the application of new and creative, systematic and robust processes, which describe potential or actual results and impacts, as well as policy options. Contributions to this conference theme should focus on but not be limited to:

– General principles underlying the combination of methods in FTA, in particular:

- Better understanding of ontological and epistemological positions that practitioners and theorists of FTA might adopt implicitly or explicitly;

- Incorporating subjectivity in FTA practices (for instance to reflect individual risk aversion) while enforcing common ethical principles;

– Methods and evaluation, in particular:

- Theoretical premises and methodology when different methods are combined;

- Methodologies and practices for assessing FTA studies that combine methods, and provision of evaluation as to which method combinations best suit which types of studies and impacts;

– Analysis of problems and possible solutions in combining qualitative and quantitative approaches, in particular:

- In relation to the use of modelling and/or simulation in combination with creative and participatory approaches dealing with uncertainty and which look at different possible futures. Contributions can amongst others relate to the extent to which approaches are complementary or contradictory, to the interfaces between approaches, the analysis of practical cases;

- 'Compatibilities' and 'incompatibilities' in combining quantitative and qualitative methods in FTA when addressing discontinuities or societal challenges;

– New tools and disciplines entering FTA, in particular:

- The use of advanced tools (e.g. Web 2.0) that help process, search, mine, organise, display, interpret and model data of all sorts. Amongst others this includes layman and expert opinions (and the scientific quality, validity and optimisation of participatory governance approaches), forecasting, and ways to reduce risks associated with the heterogeneity of information sources that feed into FTA.

- Building capacities in using the appropriate combination of tools which are fit for purpose, and communication skills required to bridge the quantitative and qualitative schools

The anchor paper on this theme is prepared by:

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COMBINATION OF THE SCENARIO WORKSHOP AND WIKI TO IMPROVE THE EFFECTIVENESS OF CONSENSUS BUILDING PROCESS

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Keywords: scenario, wiki, foresight, consensus building, workshop.

Introduction

Scenario workshops are basically meetings that involve discussions among a range of local actors, with the aim of developing visions and proposals for technological needs and possibilities in the future[1]. The use of workshops leverages the capabilities of the human mind to process varied inputs rapidly, to detect patterns amid volumes of information, and to reflect on stored knowledge and experiences, providing a powerful and effective means of integrating the diverse viewpoints needed for successful scenario building[2].

For a successful scenario workshop, the environment that all participants can exchange the information, views, and insights freely should be created. Otherwise, the workshop suffers from 'follow the leader' tendencies and reluctance to discard previously stated opinions. For the organization or society that had a strict hierarchical culture, creating such a pressure-free environment is a major factor for the successful scenario building.

It is also important to provide participants with training and information that might be related to the project. However, participants are generally very busy in doing their jobs so that they do not have a sufficient time to learn all the necessary knowledge by attending the meetings. In that sense, wiki can be alternative for participants to absorb the knowledge of topic.

In this paper, we studied the future of media devices (Smartphone, Smart TV, Tablet PC) with students as a pilot project by combining scenario workshop and wiki. A wiki enables communities to write documents collaboratively using a simple markup language and a web browser[3]. We created a collaborative wiki site and used the wiki site to identify drivers of change and to edit the scenarios.

Methodology

We applied the scenario process based on SRI Intuitive logics approach. The scenario building process is: 1) identify drivers of change 2) find key uncertainties 3) write the scenarios.

The pilot project progressed with university students. The trainings for the scenario building and the usage of wiki site were provided in the classroom. Students were very cooperative and enthusiastic about the scenario building for their grade.

1) Identify drivers of change
   - We provided students with a list of technological and social trends. Each student suggested drivers of change by STEEP analysis and then discussed to finalize the drivers on wiki based discussion site. Wiki based discussion site was developed for debate and suggest their ideas about future drivers of change.

2) Find key uncertainties
   - They evaluated the drivers on two axes, impact against uncertainty in the workshop. Especially drivers of change evaluated on high impact and high uncertainty were focused. These entire consensuses building process was conducted on wiki site.

3) Write the scenarios
   - They wrote the draft of scenarios in the workshop. In various scenario logics, 3 scenario logics per each media device were selected. They edited the scenarios through continuous feedback on the wiki site.

Results and policy impact/implications

This combined approach can be more productive than scenario workshop alone, when developing new ideas. This can overcome limitations of scenario workshop since it helps participants to discuss freely without any pressure and time limit. In particular, the wiki site can play a primary role in identifying drivers of change and writing the scenarios.

Conclusions

We combined scenario workshop and wiki to develop alternative scenarios for the future development of media devices. Three scenarios per each media device were generated using this methodology. This methodology shows advantages over scenario workshop only in that participants have same opportunities and anonymities to express their opinions freely. Also, thoughts and ideas of participants can be conveyed clearly on wiki site. However, it should be emphasized that wiki is only tool. Role of project team is more important than methodology to carry out a successful foresight project.

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Using the International Futures (IFs) Model for Scenario Analysis: Combining Quantitative and Qualitative Methods

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Keywords: International Futures, Long-Term Forecasting, Quantitative Modeling, Scenario Analysis, Quantitative and Qualitative Forecast Methods

Introduction

International Futures (IFs) is a uniquely powerful tool for the exploration of the long-term future of closely interacting policy-related issues including human development (beyond the Millennium Development Goals), social change (including instability and risk), and environmental sustainability. IFs is a large-scale, long-term, integrated global modeling system. It represents demographic, economic, energy, agricultural, socio-political, and environmental subsystems for 183 countries interacting in the global system. The central purpose of IFs is to facilitate exploration of global futures through alternative scenarios. The model is integrated with a large database for its many foundational data series since 1960. The easy-to-use interface facilitates data analysis, forecast presentation, and scenario analysis. IFs is freely available to users both on-line (www.ifs.du.edu) and in downloadable form.

Methodology

IFs is a structure-based, agent-class driven, dynamic modeling system. The demographic module uses a standard cohort-component representation. The 6-sector economic module structure is general equilibrium. The socio-political module represents life conditions, traces basic value/cultural information, and portrays various elements of formal and informal socio-political structures and processes.

The system facilitates scenario development and policy analysis via a scenario-tree that simplifies changes in framing assumptions and agent-class interventions. Scenarios can be saved for development and refinement over time. The easy-to-use interface also facilitates data analysis and display of forecasting results.

Results and policy impact/implications

IFs is used increasingly widely. It was a core component of a project exploring the New Economy sponsored by the European Commission in 2001-2003 and served the EC again in 2009 for a project examining the impact of information and computing technology (ICT) on sustainability. Forecasts from IFs supported Project 2020 (*Mapping the Global Future*) of the National Intelligence Council and also the NIC's *Global Trends 2025: A Transformed World*. IFs provided driver forecasts for the fourth Global Environment Outlook of the United Nations Environment Program.

A generous gift in 2007 established the Frederick S. Pardee Center for International Futures at the University of Denver. The Center's core project now is a series of volumes called Patterns of Potential Human Progress, modeled in part after the Human Development Report series, but forward looking (each includes substantial forecasting tables). The first volume, *Reducing Global Poverty*, appeared in late 2008 and *Advancing Global Education* appeared in late 2009. *Improving Global Health* will follow in late 2010 and volumes on global infrastructure and governance are being prepared.

Conclusions

This paper concludes by providing best-practices approaches to combining qualitative and quanitative approaches to modelling and forecasting that involve the following: 1) promote information transparency between all parties regarding underlying assumptions of both quantitative and qualitative approaches; 2) identify a scenario space that captures the key uncertainties with the most likely impact on the policy area of interest; and 3) interpret the quantitative results with a logical and robust qualitative narrative.

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SYSTEMIC FORESIGHT METHODOLOGY

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Keywords: Systems Thinking, Systemic Foresight, Foresight, Methodology, Methods

Introduction

As an unavoidable human trait of thinking about the future, foresight has existed since the existence of the first human being on earth. The use of individual foresight in a collective and participative way, however, is a rather new phenomenon, which led to today's formal, Future-oriented Technology Analysis (FTA). More recently FTA has been a widely acclaimed activity associated with policy making by government, industry and other organisations to shape the society's future. As the complexity of societies has increased, the scope of FTA activities has widened to cover a wide variety of issues. This has been mainly due to the increasing importance of technological and organisational innovation; the development of service economies; and other developments such as rapid globalisation, and changing nature of demographical structures, cultural practices, environmental affairs and social services.

Although, it is observed that the nature of the situations has changed and has become more complex and uncertain, the way FTA deals with them has remained largely unchanged. 'Systematic' processes were designed with pre-determined methods to tackle 'systemic' situations involved in human and social systems, which are 'open' in nature and require customised methodological approaches. Consequently, a need has occurred to improve the FTA practice to tackle these new situations, which require creativity and diversity in the use of FTA methods. Any new FTA approach in this regard should aim for understanding these complex systems and their behaviours, and thus needs to be 'systemic' and context dependent.

Methodology

This paper introduces the Systemic Foresight Methodology (SFM) as a way to cope better with the complexities of the human and social systems and to develop a more tailored FTA methodology with the integration of qualitative and quantitative FTA tools in line the nature of situations. The SFM sets out to create systemic concepts that are useable for future-oriented idea creation in complex human and social systems. It considers the Foresight activity as a 'systemic inquiry' where the actual design of the system can only be partially specified in

advance of system operation. This is because, when human and social systems are dealt with, the most thoughtful and carefully designed systems may have unintended consequences. System behaviour and informal structure emerge only through system operation regardless of the detail or diligence in design efforts prior to system deployment. The over-specification of a system's requirements (i) wastes limited resources, (ii) reduces system autonomy, which means the agility and flexibility of the system to respond to environmental shifts are reduced, and (iii) fails to permit subsystem elements to self-organise based on their contextual knowledge, understanding and proximity to the operating environment.

The SFM sees the design of an institutional Foresight activity as a creative process that will be engaged in designing a future system to fulfil goals and expectations. Therefore, the SFM specifies only the minimal requirements necessary to achieve the systems objectives. Thus, the SFM suggests a learning system, which structures a systems-based debate to formulate the basic 'mental acts' of (i) Systemic understanding, (ii) Systems synthesis and modelling, (iii) Systemic analysis and selection, (iv) Systemic transformation, and (v) Systemic action

Each of these steps aims at guiding Foresight practitioners to set their agendas for the different phases of the Foresight activity and to give direction to their thinking processes. The benefits of this approach lies in its systemic guiding (1) to the design of a Foresight methodology, which fits well with the context and content of the exercise, and thus (2) to decision making involved in thinking about the future and connecting the future with the present.

The mental acts explain how systems such as human and social systems, industrial and sectoral systems, and innovation systems are understood, approached and intervened for a successful change process. They follow each other, as the steps of the Foresight process, but they are iterative and can be repeated as many times until the practitioners believe that their complete function has been fulfilled.

Results and policy impact/implications

Conducting Foresight systemically involves a set of thought experiments, which is about how systems are understood, modelled and intervened for a successful change programme. Therefore, SFM does not attempt to impose any methods from the earlier phases of the systemic inquiry. Rather, a set of thought experiments are suggested to provide an epistemological framework for the construction of an evolutionary Foresight methodology, which involves:

1. **Information** to understand complex interactions between products, services, users and other stakeholders in multiple contexts in which these products and services are used

2. **Intelligence** through scanning to explore novel ideas, unexpected issues and shocks, as well as persistent problems or trends

3. **Imagination** in a holistic innovation ecosystem by integrating Foresight, Creativity and Design for scientifically possible, technologically feasible and socially desirable futures

4.   **Interaction** with the systematic involvement of stakeholders in an inclusive process with long-term perspective for the analysis of different perspectives and their social relations in the system,

and finally with an effective **Implementation** for a successful transformation programme.

Conclusions

The SFM described in this paper provides theoretical and conceptual frameworks for the design of a methodology with the selection and integration appropriate mixture of FTA methods. The approach will be demonstrated with a case study on the future of Renewable Energies.

RETHINKING THE EXPERTISE OF EXPERTS IN ASSESSING DISRUPTIVELY TRANSFORMATIVE FUTURES

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Keywords: Delphi, experts, journalism.

Introduction

The Delphi technique leans on three basic principles, equally emphasized in the traditional version of the Delphi (Linstone & Turoff 1975; 2010) as well as in the more recent updates of the technique (Tapio 2002). The core elements of the method include anonymous experts responding to other experts´ insights in an iterative manner over multiple rounds. The third assumption is that the quality of the panelists´ expertise transfers to the quality of the results, usually interpreted as a correlation between highest possible expertise and the best possible quality of the insights, and often leading to very quantitative criteria of a desirable expert panel (measured as years of experience from a given field or other quantifiable merits). Recently research from behavioral sciences (Tetlock 2005) has accumulated evidence that seems to question and even contradict common interpretations about the latter assumption. A longitudinal study over 20 years on political experts´ insights about the development of their field revealed that cognitive traits of individual experts have significant effect on their ability to assimilate contradicting information to their mental models, suggesting that on occasion dilettantes with a high degree of general knowledge can provide more insightful views on the future. In this study we suggest a method to combine these inputs from the behavioral studies to the Delphi method.

Methodology

To study the much contested, disruptively transformative future of prosumerism in news media, we assembled two Delphi panels, one based on the traditional criteria for an expert panel, the other composed of a sample of professional futurists, here representing a group with high general knowledge but a lesser amount of task specific expertise of the topic. In phase I, the experts participated in a two round Argumentative Policy Delphi about the future of journalism. The results were written into four images of the future. The experts were asked to review the

four images of the future in terms of perceived subjective likelihood and desirability. In phase II, the four images of the future along with a selection of background information about media usage trends were subjected to the panel of futurists. The futurists´ task was to review the four images of the future in terms of perceived subjective likelihood and desirability, and to imagine innovative breakthrough technologies and suggest a fifth image of the future that would differ from the four previous ones.

Results and policy impact/implications

The study offers support to the hypothesis that expert scenario work can be enriched by adding an "enlightened outsider" –view to the problem. The experience from this pilot study suggests that the approach presented here could look especially promising if applied to sc. wicked problems, where problem solving often depends on the way the problem is framed, and where stakeholders often have radically different perspectives to the issue. Also, a fertile development path could be to aggregate the approach with Integrated Assessment Modelling.

Conclusions

The experimental mix of quantitative and qualitative methods in conducting the Delphis combined the insights from field experts and futurists with the intent to provide decision-making support for various policy options by different stakeholders regarding the development of journalism, press and media. This study at hand suggests promising new ways to approach expert foresight methods. In the future, it could be developed into a method bridging, for example, experts and political decision makers.

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ORDER YOUR IMAGES OF THE FUTURE HERE

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Keywords: Images, frameworks, narratives, uses and gratifications

Introduction

Ray Bradbury's 1983 science fiction story *The Toynbee Convector* revolves around the idea of (faked) time-travel to collect (produce) and distribute (desirable) images of the future. In the story such images impact directly and strongly on future history. In 2005, at the Second Prague Workshop on Futures Studies Methodology of CESES at the Charles University in Prague, the author held a workshop experiment inspired by that story.

At that workshop participants were invited to imagine that it would be possible for the two man team presenting the experiment, to travel in time and go to the towns of Brussels and Prague of the year 2035. Moreover, they could go to any of the possible futures of these towns and bring back visual records from those futures. We asked: which images would be most useful to you? Images that portray positive or negative developments? Images representing the activities of what sectors, showing what kind of changes in the physical environment, depicting what aspects of daily life, could be put to use in your work of today?

The results from this experiment indicated that the real use-value of images of the future was not clearly determined or defined for most of the 13 workshop participants who took part. Our customary frameworks for thinking and talking about FTA do not tell us what we can do with images but have us rely on abstract analysis and narratives on the future. Methods for working out stories about the future (scenario's) or for identifying measurable trends are emphasised. How images help us communicate and think about future possibilities is often ignored. This paper summarises the existing literature on the use-value of images of the future for futures practitioners.

At the 4th edition of the International Seville Conference on FTA, we propose to repeat an extended and updated version of the experiment held five years ago in Prague, this time with a larger group of experts and with a more detailed survey. First we will pay attention to the nature of images and imagery already used by these experts with a questionnaire on the role of images in their daily practice. Second, on the order form accompanying the questionnaire, we will challenge them to imagine and describe a picture that would be truly useful to them in their future oriented work.

The idea of open futures with multiple possibilities does not exclude that different use-values can be ascribed to different kinds of images of the future. This use-value is determined not just by the encoding of the image itself but also by its contextualisation, place and manner of presentation. The scope of the questions in this paper is there for not limited to the substance of the images used or

desired for use by FTA experts. The question how these experts, if they could have any image of the future at their disposal, would propose to use them is equally relevant.

Involved with alternative scenarios and paying attention to possible, plausible and preferable futures, the experts who participated in the original experiment were clearly in the habit of dealing with 'real' futures. Presented with the idea of time travel, they were often more tempted by the idea of being able to find out the truth about the future than about the idea of being able to demonstrate a possible future. We will therefore pay attention to the difference between the use of images as "proof" of one single future possibility, as illustration of a possibility or as a trigger and a tool for lively imagination. We will also consider defining characteristics of the images ordered. What places, objects or activities do they show? What themes do they touch upon? Are they positive or negative? Are they inspired by the past? What is their time-horizon? Where would they be used, for what audience, with what intended effect?

Methodology

A background account of the historical use of images of the future in FTA and other futures fields will serve as the basis for the development of a questionnaire and order form. Participants in the survey are invited to fill these out; this can in part take place prior the conference and in part during the conference. The results of the survey will be collated, analysed and interpreted afterwards and presented in the final paper introduced here.
During the presentation of this paper, traditional, conventional as well as creative uses and gratifications of images of the future will be discussed. In particular, we will pay attention to the motivations for specific orders from the experts. The feedback from this discussion will be used in the analysis and interpretation of the survey results. The substance of images used/useable in the context of FTA will be examined and described as well as potential modes of deployment of these images.

Results and policy impact/implications

The image has significantly gained ground in today's environment of rich communication and the use of imagery may strengthen the cause of FTA wanting to deal with grand societal change. For this potential to be realisable, FTA experts need to understand their own relationship with images and imagery more profoundly. The type of research proposed here, may help clarify this relationship as well as providing an overview of the possible uses and gratifications of images of the future in a world of profound change. Moving away from philosophical/historical understandings of the meaning of images of the future and aiming more directly at practical implications of the prevalence of imagery, the recognition of the role of images in FTA may strengthen the field's impact on popular imagination as well as in policy environments.

Conclusions

Building on the exploratory work done in Prague, we zoom in on the use-value and creative potential of images of the future for FTA experts. The experiment will be successful if as a consequence of participating, a considerable portion of the experts deepen their understanding of their own relationship with images and imagery in the context of their future oriented work.

FUTURE SCENARIOS TO INSPIRE INNOVATIONS

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Abstract

In recent years, and accentuated by the economic and financial crisis, complex global issues have moved to the forefront of EU policy making. These grand challenges cut across different policy domains and hence cannot be addressed from a specific sectoral point of view alone. The EU 2020 strategy supporting the transition towards sustainability is seen as the process of coming to terms with the grand challenges in all its ecological, social, economic and institutional dimensions. This process is as much about innovation and the future, as it is about implementing present technologies and (risk) management practices.   Thinking about the future in forms of scenarios implies imaging it in ways it might, should or should not come into reality. But is the near future – or the end of the present - still open? Or is it already occupied by political visions, economical interests and technological unfolding? What innovations deserve our immediate interest? Why is the future given less value than the present, as reflected in the current and continuous attempts to discount the future of our natural environment?   In this paper the authors will motivate that new methods are emerging for orienting innovation systems towards sustainability. Participatory scenario analysis could be one of these promising methodologies. The authors will focus on the question how scenario analysis can be used as a tool that supports innovation, in theory as well as in practice. The key methodological issue at stake is why scenarios are more often used to explore potential future risks instead of inspiring sustainable innovations. Are inherent assumptions imbedded in the scenario methodology in favour of this risk approach, or is this more related with the past and current practitioners or sponsors of scenario studies? The paper will first provide an overview of new emerging concepts and paradigms from different scientific disciplines such as future studies, innovation research, sociology, policy analysis and global environmental change. These theoretical insights will then be used to analyse the selected European case studies with a focus on disruptive transformations. The empirical analysis will strongly focus on the comparison of the different scenario processes, the related outcomes and indications of the impact on decision-making. Issues of interest are how applied or perceived notions of time, non-linear knowledge, multiple stakeholder values and sustainability transitions are initiating incentives or barriers for innovation in the scenario process. These empirical findings will then be reflected back to scenario methodology providing new insights to inspire processes that support innovation addressing the grand challenges.

COMPETITIVENESS MONITOR: AN INTEGRATED FORESIGHT PLATFORM FOR THE GERMAN LEADING-EDGE CLUSTER IN LOGISTICS

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Keywords: Strategic Planning, Foresight, Information Technology, Supply Chain Management.

Introduction

In July 2010 the German Federal Ministry of Education and Research launched Germany's biggest research project in the area of logistics and supply chain management. In the leading-edge cluster 'EffizienzCluster LogistikRuhr' 130 stakeholders from industry and academia participate in 28 research projects in order to address the key challenge to a sustainable future of mobility and transport; meeting tomorrow's needs with 75% of today's resources. In this context it is essential to provide a platform that utilizes the cluster's potential in sharing complementary resources and specifically in sharing knowledge that is relevant for future-oriented decisions. The Competitiveness Monitor (CoMo), as one research project in the cluster, develops such a platform.

Methodology

CoMo develops a future-oriented IT platform where science, business, and politics co-operate to ensure a sustainable competitive advantage for all stakeholders and innovations in the EfficiencyCluster. We have identified four major challenges for CoMo: (1) creating, linking, and processing information about future macro- and microeconomic developments in logistics and its environment; (2) providing educative information on futures studies and teaching futures skills; (3) incentivizing stakeholders to systematically deal with their futures; and (4) stimulate

co-operation among cluster stakeholders. In order to address these challenges we will develop three innovative foresight tools that support strategic planning and future-oriented decision making and integrate them in an internet-based foresight platform. We will focus on the content related to the EfficiencyCluster including logistics and related topics, but the platform will be open to address other industries and functions at a later stage. First, a trend database will combine and link qualitative and quantitative future-oriented knowledge on the clusters core nature – mobility, supply chains and logistics. Value, validity, and relevance result from co-operation, co-creation, and external- and internal linkage, generating a robust decision basis for foresight activities (Surowiecki, 2004; Kane & Fichman, 2009; Auer & Lehmann, 2010). Second, trends are projected into individuals' futures and recommended actions can be derived in digital future workshops. For example, drivers and inhibitors of sustainable development can be assessed in process controlled foresight tools such as scenario analysis. Finally, prediction markets provide an innovative forecasting environment that incentivizes stakeholders of the EfficiencyCluster to participate on global and specific supply chain management and logistics topics (Ho and Chen 2007).

Results, policy impact and implications

The cooperative nature of the platform increases transparency and access to knowledge for all stakeholders in the cluster. We reduce information asymmetries and increase the velocity of communication and innovation potential. Partners of the EfficiencyCluster are involved in sustaining actuality, validity, and relevancy of future-relevant knowledge in the trend database. Prediction markets allow for incentivizing users to share individual knowledge in order to increase overall knowledge within the cluster and beyond. We will strive for a competitive advantage by addressing co-operation specific topics that are vital to overall cluster success.

Importantly, through personalization, the needs of the individual user are not neglected. Decision makers can actively shape their future combining qualitative and quantitative information from the trend database to build a robust decision space. On this basis future-oriented strategic tools provide innovative qualitative and quantitative foresight support. These will support logistics planning and thus generate an individual decision making environment.

In addition, linkage within the trend database, among the tools, and with external data creates a holistic and robust picture of relevant futures. Linkage generates the possibility to acknowledge trends early and systematically. Decision makers can identify early warnings and weak signals and consequently react faster to sudden changes in their futures. This creates a significant competitive advantage for the cluster. In addition, policy decision makers will be able to share insights into legislation processes and get involved in market trendsetting.

Conclusions

The combination of a trend database, future workshops, and prediction markets in an internet-based future platform facilitates cooperation, provides a shared future-relevant knowledge basis, and ensures individual future-oriented decision support. Ultimately, the CoMo project contributes to the superior aim of Germany's biggest research cluster in logistics by fostering

stakeholders' future-oriented decision quality. Thus, sustainable success of innovations and competitive advantages of stakeholders in the cluster can be achieved.

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TREND DATABASE DESIGN FOR EFFECTIVELY MANAGING FORESIGHT KNOWLEDGE – A SOPHISTICATED FTA CONTENT BASE ARCHITECTURE TO ENABLE FORESIGHT PROCESSES

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Keywords: Trend database, Foresight, Supply Chain Management, Information Technology, Strategic Planning

Introduction

With the intention of furthering their objective of developing a highly innovative and sustainable logistics industry, in 2010 the German Federal Government launched one of its biggest research initiatives in the area of logistics and supply chain management – the EfficiencyCluster LogisticsRuhr. Overall, 130 companies and organisations, including 56 small and medium sized enterprises and 11 research institutes and universities, cooperate in 28 research projects on emerging topics and challenges in logistics. One of the projects deals with the development of an innovative, web-based Foresight Platform, which supports strategic decision making and contingency planning as well as competitive and environmental intelligence. Called the 'Competitiveness Monitor' (CoMo), it aims to leverage innovation potential and synergy in order to generate competitive advantages for all the cluster partners.

The CoMo consists of three innovative foresight tools – (1) Trend Database (TDB), (2) Prediction Market and (3) Future Workshop ("Zukunftswerkstatt") – which are integrated into an IT-based (4) Foresight Platform. The TDB determines the heart of the CoMo by providing and storing knowledge relevant for future competitiveness. For this reason, challenging demands are made to the characteristics and functions of the TDB.

Methodology

Since the beginning of our project in mid-2010 we have conducted a thorough market analysis and compared eight existing TDB architectures. Through this we have gained an overview of the state-of-the-art of existing foresight database tools. Furthermore, we have conducted several participatory workshop sessions and developed relevant use cases to add further requirements from a user perspective. Close collaboration between the project experts from a large manufacturing corporation, a supply chain management consultancy, an IT service provider and an academic research institution ensured high levels of scientific rigor and industry relevance as well as large-scale usability for later stakeholders in the EfficiencyCluster. The identification and analysis of requirements has been systematically conducted, following the 'Volere Requirements Specification Template' (Robertson and Robertson 2006). Through the comparison of the results of the TDB concept analysis and the requirement analysis we were able to identify and evaluate today's core challenges in TDB design and architecture.

Results and policy impact/implications

Our analysis of existing TDB concepts and the requirement specification process within the CoMo project team have revealed four main challenges: (1) Extensiveness and quality of trend information, (2) Cooperation within the TDB-community, (3) Linking mechanisms and (4) Incentive mechanisms for users. The extensiveness and the quality of the knowledge are relevant in supporting the user with all required information. Thereby, we will present data and information in a clear structure to facilitate finding relevant information. Co-creation is a central topic of the CoMo project, which can bring substantial benefits for stakeholders (see e.g. Hoyer, Chandy et al. 2010), e.g. by providing an accurate and holistic picture of the future according to the 'wisdom of the crowds' (Surowiecki 2004). Besides the information itself, the intelligent linkage of data is essential for TDB users. The CoMo TDB will distinguish between three linkage mechanisms: the linkage of trends amongst each other, the linkage of foresight tools within the CoMo and the linkage with other external data pools. The latter we will implement with the concept of a Semantic Web, a machine-readable and value-creating network of linked data (Berners-Lee, Hendler et al. 2001) in which computers and programs can locate and integrate information without human intervention (Horrocks 2008). However the participation of users is required here as well since the datasets need to be linked manually before the advantages of a Semantic Web can be implemented. Thus, the incentive mechanisms for users to share their knowledge within the community and to process the stored knowledge is essential for the success of the CoMo project's TDB.

Conclusions

Most of the currently existing TDBs provide their content via a panel of experts, which collects and edits trends and weak signals. However, current tendencies such as the increasing number of members in social communities or the disclosure of previously protected data (i.e. open source / innovation) suggest that existing concepts need to be adapted to the changing requirement basis in order to remain competitive. Therefore we acknowledge these novel business demands and develop an innovative TDB concept that integrates modern linkage and collaboration approaches.

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Web 2.0 for Foresight: Experiences on an Innovation Platform in European Agenda Setting

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Keywords: social platforms, web 2.0 and FTA, innovation, priority setting, community building.

Introduction

While the private sector has already discovered the wide set of benefits of web 2.0 technologies (McKinsey, 2009), the public sector is only beginning to use these tools. Especially the use of interactive and collaborative tools in FTA for priority setting has been rather limited until today. This paper focuses in particular on the use of social web platforms in steering innovation efforts. It analyses how the objectives, design, outcomes and impact web 2.0 foresight processes differ from other participatory processes and how future-oriented information can be collected in such approach.

Methodology

Compared to more traditional ways of stakeholder involvement, social web platforms introduce real time feedback into the process of stakeholder involvement, which allows for a much more interactive and collaborative involvement fundamentally changing the way opinions are collected. The paper identifies factors that influence on the design of web 2.0 processes in support of

innovation policy and how those differ from more traditional ways of stakeholder involvement. Then a conceptual framework is constructed building on experiences in conventional FTA processes and in use of web 2.0 in other areas (Shannon et al, 2009; Dinesh et al, 2010).

This framework is then attested against the design and implementation of a foresight case of the European Institute of Innovation and Technology (EIT) in collaboration with JRC-IPTS, where a web 2.0 ideation platform was used to collect ideas from research and development communities across the globe for world leading innovation that integrate education, business and research with a specific thematic focus. The case study includes an idea collection phase, an idea assessment phase, an analytical phase and a validation workshop. The results of the study serve as support to the EIT Governing Board in defining the contents of the EIT's first Strategic Innovation Agenda in 2011 and priority themes after 2013. The findings of the case study are reported and used to propose refinements to the framework.

The proposed framework also has wider implications for decision-making processes in priority setting. The paper discusses a number of barriers to a wider use of web 2.0 in the public sector (Accenture, 2009), and more specifically in steering research and innovation efforts, and proposes ways to overcome these barriers. Finally, it is also used to explore how web 2.0 supports community building in innovation development.

Results and policy impact/implications

The proposed framework and the case study suggest that the use interactive and collaborative tools in stakeholder engagement requires a different approach towards the design and implementation of foresight processes. Additional implications include the potential of these tools to integrate data types of all sorts and opportunities to use web 2.0 platforms to support the creation of communities under certain circumstances.

Conclusions

The paper offers some new insights into the design and implementation of web-based interactive and collaborative foresight projects in support of policy and decision-making in general, and innovation policies more specifically. It also indicates barriers to a wider use of such tools in policy and decision-making, and opportunities for embedding them, thus improving transparency and supporting community building.

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Developing a Backcasting Approach for Systemic Transformations towards Sustainable Mobility - The Case of the Automotive Industry in Germany

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Keywords: Backcasting, real-time Delphi, automotive industry.

Introduction

Radical systemic changes to current systems of mobility, especially in industrialized countries, are required to achieve sustainable development (Nykvist & Whitmarsh, 2008). These changes on a system level are referred to as systemic industrial transformations towards sustainability. Such transformations require combinations of technological, cultural, societal, institutional, and organisational aspects, while affecting many stakeholders when diffusing into society and involving complex processes of societal change on the long term (Quist & Vergragt, 2006). Transformations towards sustainability in mobility are very complex phenomena: inherent uncertainty of technological and infrastructural developments and the inherent ambiguity of stakeholders having different value sets and mental frameworks. Within the field of FTA an emerging approach for achieving transitions towards a sustainable future is backcasting. We demonstrate how an innovative backcasting process can be applied to analyze possible transformations to sustainable mobility in Germany.

Methodology

Backcasting incorporates developing a desirable future scenario and looking back at how this can be achieved, before defining appropriate strategies (Höjer, Gullberg, & Pettersson; Quist & Vergragt, 2006; Robinson, 1988). We designed an innovative backcasting process by implementing four steps including an internet-based, real-time Delphi survey (Gordon & Pease, 2006). The first step "Strategic Problem Orientation" is the problem definition and description of the current situation in a qualitative way by executing participatory workshops with dedicated experts from major stakeholder groups. In the second part "Development of Future Images and Influencing Factors", a sample of 140 experts from 15 different stakeholder groups (academics, car manufacturers, suppliers, service providers, associations, etc.) provided estimations on 20 future projections concerning probability, desirability, and impact based on a real-time Delphi survey. Resulting from this survey, scenarios were developed and influencing factors were identified: Delphi participants' answers were statistically analyzed in order to identify a desirable future scenario. Furthermore, by systematically coding the

participants' arguments the major influencing factors for the transition paths to the desirable scenario were identified. Thirdly, in the step "Development of Measures", backcasting interviews based on a standardized interview guide with more than 40 experts from various stakeholder groups have been conducted in order to discuss measures on the transition to the desirable scenario. For this step we developed an innovative backcasting template to ensure reliability in the research process. The fourth step "Follow-up" includes the dissemination of results and recommendations in participatory workshops with the relevant stakeholders.

Results and policy impact/implications

We developed a desirable and a probable scenario as well as influencing factors on the way to the desirable scenario. Based on the semi-structured interviews we elaborated on the path towards the desirable scenario. The analysis included appropriate measures, existing pitfalls, and involvement and action of different stakeholders. We were able to develop and text a backcasting exercise that combines the advantages of quantitative and qualitative methods. The goal was to combine the structured method real-time Delphi survey, where the results can be analyzed with the help of statistical methods, and more open and qualitatively oriented methods based on semi-structured interviews and coding of arguments.

Conclusions

So far, backcasting has been applied using a number of different techniques. Mostly, however, focus groups were used to develop scenarios or measures on the pathway towards a desirable future. In our backcasting approach, we show how real-time Delphi and interviews can be combined in order to tackle sustainability problems such as sustainable mobility in Germany in a very structured discussion. Specifically, with the help of combining real-time Delphi and semi-structured in-depth interviews, shortcomings of focus groups such as the suppression of alternative opinions could be circumvented. Furthermore, by using an internet-based real-time Delphi survey and individual interviews via telephone we were able to include a sample of 140 experts in the Delphi step and 43 participants in the interviews, coming from 15 different groups in each case. Thereby, we achieved a "truly" multifaceted view as well as high cross-validity.

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FUTURE OF TRANSPORT: FORESIGHT AND FORWARD LOOKING ACTIVITIES

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Introduction

In the past few years a large number of Foresight and Forward Looking activities regarding the Future of Transport were performed at a European and national scale. Regarding the outcome as regards to content, more similarities than differences can be noticed. However, differences regarding the outcome are due to the arenas the activities were performed for. Observed particularities are of high interest to be discussed from a policy studies point of perspective.

Methodology

Methodological approach: Studying different European and National Foresight and Forward Looking activities in the transport and technology sector performed in the past few years. Discussing these activities regarding the public administration and policy arenas they were planned and performed for.

The paper will focus on different types of foresight and forward looking activities. Differences and similarities will be worked out and the outcome of these activities discussed. The paper pledges for a combination of foresight and forward looks to interlink forward projection approaches with visionary and interactive approaches. Both approaches have advantages and disadvantages. While forward projections in common do not sufficiently take into account radical regime shifts. Visionary approaches tend to get avantgardist in technology architectures.

Results and policy impact/implications

The context and function of foresight and forward looks in a particular policy or public administration arena is often not sufficiently taken into account. However, to remind the context and understand the policy arrangement before starting a foresight process is crucial regarding its later impact and implications.

Conclusions

It will be discussed, what role foresight activities do play in different policy and public administration arenas. A critical perspective will be taken looking at different types of foresight and forward looking activities ant their entitlements to shape the future.

A PROBLEM-ORIENTED CATEGORISATION OF FTA-METHODS FOR TRANSPORT PLANNING

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Keywords: FTA methods, transport planning, uncertainties, unintended effects.

Introduction

Various examples illustrate that governing transport is a complex task, which makes it difficult to correctly and entirely anticipate the effects of policy making (see TSU Oxford et al. 2010, also Kleindorfer 2008). In many cases policy interventions lead to unintended or adverse effects. We differentiate between unintended effects that have been well-known in advance ("knowns"), effects that have only been roughly anticipated ("known unknowns"), and effects that are completely surprising ("unknown unknowns"). As in other socio-technical fields, a broad range of rather different FTA-methods are used in transport planning to improve the quality, robustness and legitimacy of decisions. Potential effects of policy interventions and innovations need to be assessed; risks and uncertainties have to be reduced. Given the complexity and interrelated dynamics in many socio-technical fields, it is in general not possible to use only one method; it is essential to use different FTA- tools and methods in an appropriate and tailored manner. For example, both the demand side as well as the supply side have to be analysed to assess the potentials and consequences of interventions in the transport sector.

It can be observed that a wide range of tools and methods are applied in context of prospective analyses of the effects of policy interventions in the transport system (see DLR, KIT 2010; Justen et al. 2010). There are computer-based modelling efforts to quantify trends and their interrelations; there are as well methods based on expert dialogue, discussions and citizen or stakeholder participation, which intend to examine alternative possibilities, to generate visions of desirable futures or to anticipate unintended effects of policies. None of these methods are able to systematically reproduce a complete system, they all have their limits. For example, methods such as transport models only show a pre-defined segment of the broader system, whereas other methods might only provide selected knowledge from rather different areas (brainstorming, open space or a focus group).

Methodology

This contribution compares the pros and cons of various FTA-methods for the detection of different kinds of unintended effects. On this basis, a rather transparent and problem-oriented typology of FTA-methods is suggested and discussed in relation to several examples. It is assumed that such a categorisation of methods is helpful as a basis for an appropriate usage of FTA-methods in the process of policy making. Key criteria for the categorisation of tools and methods are their abilities in detecting different types of unintended effects in the transport system and beyond. In doing so, the typology supports the application of systematic and robust FTA-processes.

Results and policy impact/implications

A general distinction between two groups of tools is made according to the following criteria: Does the structure of the method allow for a high degree in openness concerning the inclusion of parameters and linkages between parameters or is the method instead characterised by a pre-defined set of nodes and linkages between these nodes? Accordingly, two categories are introduced which are called 'structurally open methods' (for example public participation or expert workshops) and 'structurally closed methods' (for example transport models). The rather "classical" distinction between qualitative and quantitative data is a relevant element of this categorisation. However, the dichotomy openness/closeness is used as the main criterion since it seems to be highly important for the type of unintended effects, risks or uncertainties that can be detected with a method (DLR, KIT 2010). A third category will be discussed to describe typical examples for mixed approaches combining structurally open and structurally closed methods (examples are scenario processes or roadmapping activities). Using examples from the transport sector, there will be discussion on which methods should be applied or combined for which kind of problems and at which stage in the process of policy making.

Conclusions

For different phases of the planning process either more open or more closed methods are suitable. For example, in the EU-FP7 project OPTIC it is concluded, that structurally open methods should rather be used in an explorative phase at the beginning of a planning process, structurally closed methods should be used in the middle, and more open methods should be used at the end again. Accordingly, elements of both categories need to be combined in a systematic way to achieve sound results (see DLR, KIT 2010; Justen et al. 2010).

Such a problem-oriented categorisation of FTA methods is assumed to support a better understanding of the potentials of different methods. Furthermore, it helps to sharpen sensitivity for risk and uncertainties in planning processes. In addition, the methodology should in particular increase awareness for a more careful design and integration of structurally open methods.

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CONSISTENT CONTEXT SCENARIOS: A NEW APPROACH TO 'STORY AND SIMULATION'

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Keywords: environmental futures, scenario methods, simulation, consistency, cross-impact balance analysis

Introduction

Over the last decade, scenarios of (global) environmental change often have been developed by an approach labelled "Story And Simulation" (SAS) (Alcamo 2008). The basic idea of SAS is to explore futures of coupled human-natural systems via numerical simulation models combined with qualitative storylines (or 'narratives') (see also Kemp-Benedict 2004, Winterscheid 2008). This approach has important strengths compared to 'quantitative modeling only' approaches. For instance, SAS allows doing justice to the uncertainty and the (in part) qualitative character of future social, political and economical developments. Scenarios resulting from SAS processes have been used both for scientific purposes and have become relevant for informing and structuring public and political debates, e.g. the so called SRES scenarios published by the IPCC (Nakicenovic et al. 2007). At the same time, scenarios generated via SAS have been criticized in terms of usefulness and credibility (e.g. Girod et al. 2002; Schweizer 2007; Parson 2008). We focus on two weaknesses of SAS: first, there is a methodological imbalance, as SAS combines formal and systematic modeling on the one hand with creative scenario techniques as 'intuitive logics' with rather weak transparency and scientific credibility on the other hand. Second, a basic idea of SAS is that the coupling with mathematical models allows checking the internal consistency of the storylines (e.g. Alcamo 2008: 137). There are hints that this promise might be difficult to hold in practice (see Schweizer 2007 with regard to the SRES scenarios).

Therefore, we identify possible methodological variants of SAS and discuss a new approach: We propose to test the combination of the cross-impact balance analysis (CIB) (Weimer-Jehle 2006) with simulation models. CIB is a qualitative but systematic form of systems analysis using a balance algorithm to generate consistent scenarios. We ask, how CIB could be used within a new approach to SAS and what potential benefits and limits we can expect from 'CIBAS' (i.e. 'CIB And Simulation').

Methodology

This work is mainly based on literature review. SAS is described and discussed with regard to its strengths and weaknesses. Based on review of literature on CIB and on general conceptual

thoughts on scenario processes combining simulation models with qualitative scenario techniques, we deduce conceptual ideas on 'CIBAS' and formulate expectations on potential and limits of its application.

Results and policy impact/implications

In practice, processes combining qualitative scenario techniques and simulation models can be designed in multiple forms. Their design depends on variables as the 'division of labor' between the two components, the 'distribution of power', the timing and positioning, the structure of overlap between the scopes, the degree and structure of coupling and on the scenario technique applied. But their design also depends on the (social) contexts of their application and use.

Generally, within CIBAS the 'intuitive logics' approach of SAS could be complemented or replaced by the systematic CIB. CIBAS is imaginable either in form of 'consistent context scenarios', in which CIB scenarios provide numerical models with information about the 'outside world' in form of (harmonized) consistent context scenarios, which can be used as qualitative background information and/or as input parameter for simulation runs. Or, CIBAS could be designed in form of 'integration tools' in which CIB scenarios provide an interdisciplinary conceptual framework that can be linked in multiple ways with several coupled numerical models.

We expect CIBAS a) to balance the methodological imbalance of SAS by its systematic and transparent approach; b) to assure the internal consistency of the qualitative scenarios via CIB; c) to support the reproducibility of the scenario *process* (not the result) by explicitly documenting underlying mental models including their assumptions on interrelations. Still, in practice, we expect CIBAS to be ridden with many of the same prerequisites as the ideal type SAS: e.g., the translation of verbal into numerical statements remains a challenge. Furthermore, CIBAS might tend to overemphasize causal relationships.

Conclusions

Our work suggests that the concept of SAS can – at least in part – be improved by new approaches, e.g., by the combination of cross-impact balance analysis and simulation ('CIBAS'). Mainly, we expect CIBAS to alleviate the methodological imbalance of SAS and to carry through its 'promise of consistency'. Overall, the expected benefits of CIBAS suggest that it could enhance the usefulness and credibility of SAS processes for internal scientific users as well as for external non-scientific users. CIBAS and its different methodological variations now have to be explored and tested empirically. We currently initiate different case studies.

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TECHNOLOGY LIFE CYCLE ANALYSIS MODELING BASED ON PATENT ANALYSIS

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Keywords: technology life cycle, patent, indicator, cathode ray tube, Thin Film Transistor liquid crystal display, nano-biosensor.

Introduction

The Technology Life Cycle (TLC) concerns the full spectrum from R&D through commercialization. Patents and trademarks are important elements of the TLC system reflecting the goal of maximizing profit by protecting the investment of the organization in pursuing R&D. The major approach to analyzing TLC comes from the observation that technological performance data often show an S-shaped relationship, either over time or cumulative R&D expenditures. Usually, patent application activity is tracked as a TLC indicator for the S-shaped analysis. But using the patent application counts alone to represent the development of technology oversimplifies the situation. Accordingly, some complicated indicators are used to measure TLC. Watts and Porter (1997) introduced 9 indicators that look at publications of different types during the technology life cycle. Reinhard et al. (2007) tested 7 indicators related to patents.

In this paper, we focus on devising and assessing patent-based TLC stage indicators, and apply these indicators to an object technology to help forecast its technological development.

Methodology

The most fundamental and challenging task is to select suitable indicators and data sources.

Many researchers have studied patents as a tool to measure technological development (i.e/ Basberg, 1987). We build upon this established indicator research. In recent work (Zhang et al 2009), we have compiled candidate patent indicators from multiple sources. Through expert interviews and questionnaires, we have selected the following indicators to pursue for TLC assessment:

Number of applications, Number of assignees, Number of company assignees, Human Resource Input (Number of inventors), Number of utilities, Number of designs, Number of backward citations to science literature, Number of backward citations for patents, Number of IPC.

We now focus on particular technologies and assess their life cycle stages by means of Delphi process. Here we choose CRT (Cathode Ray Tube) and TFT-LCD (Thin Film Transistor Liquid Crystal Display) as indicator sets. We employ normalization to preprocess the CRT and TFT-LCD data of all indicators in each stage, and then obtain the features of each stage in the indicator sets by classifier (Watanabe et al., 2009). We next apply the resulting features of indicator sets to a different technology as a test case study. Here we present this for the case of nano-biosensors (NBS).

In this research, only U.S. patents are measured because inventors use their home country protection for almost every invention; furthermore, inventors feel that U.S. protection for those innovations represents significant advantages or commercial value. We choose DII as data source for most of the indicators, CASSIS for designs, VantagePoint for data cleaning and extraction.

The research framework is organized as follows:
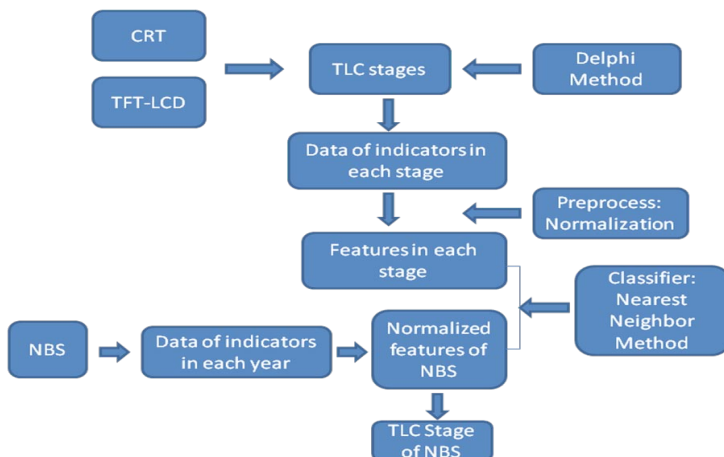
Results and policy impact/implications

We present the TLC indicators sets and their application to NBS. Results enable a technology observer to determine the current life cycle stage of a particular emerging technology of interest.

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ENERGY TRANSITIONS: ADAPTIVE POLICY MAKING UNDER DEEP UNCERTAINTY

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Keywords: deep uncertainty, adaptive policy making, robustness, Exploratory Modeling and Analysis, exploration of plausible futures.

Introduction

Deep uncertainty can be defined as the situations where the parties to a decision cannot agree on model representation, probability distributions in the model and the evaluation of the outcomes (Lempert et al, 2003). In the presence of deep uncertainty, decision making becomes a difficult task. Several method(ologie)s –mostly model-based– have been developed and are currently used for dealing with this difficulty. Models are often considered to be mathematical representations of real world systems where modelers make certain assumptions about the system of interest. When using models to predict the future, modelers assume their models to be true. However, under deep uncertainty, that claim does not hold.

In policy making, one most common way is still to seek an optimal policy which outperforms all other alternatives. However, in the presence of deep uncertainty, the assumptions under which optimal policies are chosen may not hold anymore. *Adaptive* and *robust* policies that perform well enough across an ensemble of plausible futures may well be preferable over static policies that are optimal for one or few futures (Lempert et al, 2003). Hence, there is a strong need for not static but adaptive policies which are "more robust to a range of anticipated conditions and can adapt over time" (Swanson et al, 2010).

In this paper, a new research methodology, *Exploratory Modeling and Analysis (EMA),* for improving *adaptive* policy making under *deep uncertainty* is presented. The performance of EMA on adaptive policy making is illustrated with a case study about the transition of energy systems, which is a long-term and deeply uncertain dynamically complex issue.

Methodology

Exploratory Modeling and Analysis (EMA) (Agusdinata, 2008) is a new research methodology for exploring and analyzing deep uncertainty and supporting long term strategic policy-making under deep uncertainty by using computational experiments. EMA is not a modeling technique by itself. Instead, it is a methodology for using models in an explorative way - more specifically more aggregated and still useful models. In this paper, a System Dynamics (SD) model about energy transitions is used for deep uncertainty analysis. Major steps in EMA are: (1) specification of the uncertainties (parametric and/or structural), (2) development of fast and simple computer models of the system, (3) exploration of an ensemble of futures, (4) developing policy options, (5) comparison of the performance of the policies and (6) policy recommendation.

The initial step in our analysis is to specify the parametric and structural uncertainties in the model, such as lifetimes, progress ratios, marginal costs or desired fractions of different technologies. Following that, computational experiments for exploring the uncertainty space are performed and tens of thousands of plausible scenarios are explored. After these computational experiments, adaptive policy options are developed and their performance is tested among the ensemble of futures. The outcomes are visualized with various visualization techniques to have a better understanding of the scenario space generated. Finally, adaptive and robust policies that perform well over the ensemble of futures are recommended for policy making.

Results and policy impact/implications

In our analysis, parametric and structural uncertainties in energy transitions are explored. The results show that decision making under deep uncertainty can be improved using EMA. Since the competition of new sustainable energy technologies and existing ones is an important issue for policy makers in the future, there is a strong need for decision support for developing better investment policies. Under deep uncertainty, developing long-term policies is very difficult. Static policies that are based on predictions about the future face the threat of failing or not being able to adapt over time. For this reason, policies should be adaptive and robust and it is shown in this study that adaptive policy making performs better under deep uncertainty.
Furthermore, previous practices of EMA (Pruyt, Hamarat, 2010 & 2010a) and this study illustrates that EMA is a promising methodology for improving decision support in short/long term dynamically complex and deeply uncertain policy making issues.

Conclusions

This study illustrates that it is possible to develop adaptive policies for a long-term dynamically complex and deeply uncertain problem by using EMA. As stated, the main aim is not to predict the future. Using aggregated and relatively small models, which can still grasp the general dynamics of the problem; it is possible to explore an ensemble of futures. Furthermore, adaptive policies that are robust among these future scenarios perform better under deep uncertainty. Considering the importance of the sustainable development of future energy technologies, possible investment scenarios are analyzed and plausible transition pathways for global energy technologies are shown. This study explores these transition pathways of competing energy technologies in a deeply uncertain future.

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EXPLORATORY MODELING AND ANALYSIS, AN APPROACH FOR MODEL-BASED FORESIGHT UNDER DEEP UNCERTAINTY

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Keywords: Uncertainty, Exploratory Modelling and Analysis, Adaptive Policymaking, Agent based simulation, System Dynamics.

Introduction

Future oriented technology analysis (FTA) is understood as the field interested in analysing future technology and its consequences. FTA relies on a wide array of methods for exploring futures. FTA is an umbrella term and aims to bring under a single term the work done in various future-oriented research fields, including technology forecasting, future studies, foresight, and innovation studies. These various fields have their own methods and techniques. Across these fields, various methods and techniques rely at least in part on mathematical models and computer models. We call decision support through models model-based decision support. The reason for using models might be understood in light of the rise of Newtonian mechanics and its success in predicting a wide array of phenomena. This success gave rise to a mechanistic worldview, according to which the world is like a clock. If the mechanisms of the clock are known, any future state of the clock can be predicted. Similarly, if the mechanisms underlying a phenomenon are known, we can predict how this phenomenon will develop in the future. With the rise of computers, more and more mechanisms can be codified into a model, and more and more phenomena can be predicted.

Methodology

However, the use of models to make predictions can be seriously misleading if there are profound uncertainties. The system of planets is a relatively small and isolated system in terms of components and can be very well observed and its behaviour predicted. However, for many other phenomena, such as the world's climate, or systems with social components, the situation is different. In these cases, there are many components and mechanisms that interact in a variety of ways, and the system can only partly be observed. The use of predictive models for such systems is problematic. In their agenda setting paper on FTA, Porter et al. (2004) note that "there are many irreducible uncertainties inherent in the forces driving toward an unknown future beyond the short term". There is a need for model-based support for the design of robust strategies across this spectrum of irreducible uncertainties. The RAND Corporation developed a technique called Exploratory Modelling and Analysis (EMA) tailored to this (Agusdinata, 2008,

Bankes, 1993). This paper explores the potential of EMA for FTA. It thus explicitly addresses one of the FTA challenges of Porter et al. (2004). Particular attention is given to the potential of EMA in offering decision support for shaping systemic and structural transformation. In this paper, EMA is illustrated using three cases. These cases differ in application domain, the type of models used, and the purpose of the study. In this way, together these cases offer a good overview of what EMA is about, what can be done with it, and what its potential is. Each of the cases is related to important societal challenges.

Results and policy impact/implications

The first case explores uncertainties related to the availability of minerals/metals that are crucial for the sustainable development of all developed and developing societies. There is a serious threat of future scarcity, with potential disruptive societal consequences. Utilizing an exploratory system dynamics model, potential pathways for the development of the availability of minerals and metals are explored across a wide variety of uncertainties, including economic developments, technological developments in mining and recycling, and market characteristics such as price elasticity and substitution (Pruyt, 2010). The second case shows how EMA can be used to develop adaptive plans for guiding airport development. Future uncertainty is increasing because contextual conditions are less stable, new technical solutions are emerging, and evaluation criteria are contested (Störmer et al., 2009). EMA offers a suitable approach to explore the potential implications of these uncertainties and assist in developing a dynamic adaptive plan. By iterating back and forth between the design of the plan and a model-based exploration using the computational core of the HARMOS DSS (Wijnen et al., 2008), a dynamic adaptive plan for the future development of Amsterdam Airport Schiphol emerges that is dynamically robust across the uncertainties. In the third case, we explore plausible transition trajectories for the Dutch electricity system in the face of uncertainties about institutional change, economic competitiveness of dominant fuels, emerging technologies, changing end-user preferences, etc. The consequences of these uncertainties is assessed using an agent-based model (Yücel, 2010) of the Dutch electricity system. The outputs are analysed using various data-mining and data visualization techniques in order to reveal archetypical transition trajectories and their conditions for occurring. Policy recommendations are derived from this.

Conclusions

The three cases illustrate clearly the range of applications of EMA and its potential for offering decision support for decision making under deep uncertainty. The cases also illustrate how EMA can be combined with quite distinct modelling approaches. In particular, EMA appears to be promising in helping to realize systemic transformation through its support for the design of dynamic adaptive policies.

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USING A COMBINATION OF THE COMMONKADS AND SYSTEM DYNAMICS METHODOLOGIES TO MAKE OPERATIONAL THE TRANSITION BETWEEN THE DEFINITION OF A JOINT INNOVATION STRATEGY AND ITS IMPLEMENTATION AND MANAGEMENT

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Keywords: system dynamics; balanced scorecard; CommonKADS; strategy maps; FTA thinking; joint strategy definition, implementation and management.

Introduction

The combination of Balanced Scorecard (BSC) with FTA holds the promise to set out a robust, systematic and systemic process to trigger joint innovation through research which is jointly funded by involved partners. This process combined with knowledge management approaches and supported by the CommonKADS methodology enhances the capability of the system to properly define a shared vision and its translation into a strategic research agenda (SRA) in order to reach the defined strategic objectives, and to prepare the system for the implementation of the SRA based on the options at hand and its expected impacts and possible supporting instruments.

However, most policy and decision makers face a major challenge in making operational the defined action plan or to implement the defined SRA and monitor its progress, which is critical to enable the system to become adaptive through time. Even if indicators and the necessary mechanisms to monitor these are available, policy and decision markers often fail to support and shape the process towards the defined vision. This happens because they tend to manage static and linear rather than complex and interdependent systems, and also because of individual's inability to become adaptive over time.

Despite advances in the use of strategy maps in the BSC, the latter is reinforced in such an approach. Here, the communication of strategic objectives is linear and static, since it

effectively ignores the circular effects of strategy feedbacks and delays, and also due to the unfolding unidirectional dimension of BSC. This means that there is no connection between strategy implementation and the restrictions imposed by the system [1-7] within a changing environment.

In this context, the use of the System Dynamics (SD) methodology aligned with FTA thinking help overcoming such a limitation as it supports shaping and monitoring complex and dynamic systems, thus enabling the system and individuals to become adaptive over time. This helps policy and decision markets to understand the structures and behaviours of the involved systems using two types of notation: soft modelling or cause-effect diagrams, and hard modelling or diagrams of stocks and flows. The qualitative aspect of the methodology is used to identify the structural characteristics of the system as well as cause-effect relations and feedback structures present in the behaviour of the system. The quantitative aspect of the methodology represents the use of the structural cause-effect characteristics of the system to develop a simulation model to test the system and quantify mathematically its cause-effect relationships.

Methodology

The methodology included a literature review as well as a critical and comparative analysis of several prospective studies and case examples to build a theoretical framework. The framework was tested against the objectives and instruments and tools used in these cases in order to address identified current limitations and gaps in designing, implementing and managing joint adaptive strategies.

Results and policy impact/implications

The contribution of aligned SD and FTA thinking in the context of making operational the transition between the definition of a joint innovation strategy and its implementation and management relies in the fact that it allows the development of strategic maps that connects the defined SMART objectives (elaborated using BSC) and related indicators with the circular cause-effect characteristics of the system. In this way it builds a map that shows how all elements of the system interact with one another as well as how certain policies and decisions resonate across the system. This connection takes place not only at firm level, where it enables the connection of the circular cause-effect characteristics of the system with all dimensions of the business, but also at the political and macro level since it enables these connections to link with the various interdependent policies at stake. Moreover, the resulting maps take into account also the dimension of time, which is critical to enable not only simulations of the system in different periods of time, but also to adapt the defined policies and strategies along the way as the maps are updated over time.

Conclusions

Current business maps are able to represent only a few indicators, those distributed in the BSC perspectives, losing thus the opportunity to consider emergent strategies that are not part of the

process of strategy development. The use of SD and CommonKADS aligned with FTA thinking, although requiring a high degree of commitment of an organisation, are able to expand such perspective and support a change individual behaviour to enable a firm to jointly define with selected partners an innovation strategy and, most importantly, to implement and manage this being adaptive to a changing environment.

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Text Mining of Information Resources to Inform Forecasting of Innovation Pathways

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Keywords: Forecasting Innovation Pathways; New & Emerging Science & Technologies; Tech Mining; Nanotechnology, Dye Sensitized Solar Cells

Introduction

New & Emerging Science & Technologies ("NESTs") are increasingly being studied by Future-oriented Technology Analysts because of their potentially important "emerging applications".[1] However, high uncertainty and dynamics of NESTs pose special challenges to traditional forecasting tools. Capturing and exploring multiple potential innovation pathways[2] shows considerable promise to inform technology management and research policy.

We have devised a 4-stage approach to Forecast Innovation Pathways ("FIP"). This integrates a) heavily empirical "Tech Mining" with b) heavily expert-based Multipath Mapping.

The four FIP stages blend empirical and expert knowledge. Stage 1 -- Technology description -- combines literature review and informal expert opinion. In Stage 2, we anchor FIP upon a long-established innovation system modeling framework – Technology Delivery Systems (TDS). "Tech Mining" of search results from databases such as Web of Science (fundamental research), EI Compendex (engineering R&D), Derwent World Patent Index, and Factiva (business-related information) offers rich intelligence along a technological development vector. Analyzing search results together can identify key organizations, stakeholders, and influences (e.g., policy, standards). These results can elucidate development trends and help pose questions on key needs, supports, and hurdles. Stage 3, Forecasting likely innovation paths, presents the empirically-based findings and TDS model to a diverse set of experts and stakeholders, usually via a live workshop. Once potential innovation pathways are identified, further examination of requirements and issues to achieve them helps gauge their feasibility. This also sets the stage for technology assessment, initially at the workshop, then through further research and analyses. In Stage 4, scenarios are a prime vehicle for synthesis and reporting.

Data and Methods

This paper explores systematization of the FIP analytical approach through applying artificial intelligence tools to the Tech Mining efforts.[3] We now have a set of multi-database NEST search results; we are working to devise algorithms to help extract key technology components, significant actors, and potential applications.

This analysis treats DSSC abstract records through 2010 based on searches in three databases:
- 4104 documents (including 3134 articles) appearing in Web of Science (fundamental research emphasis)
- 3730 documents from EI Compendex (journal and conference articles)
- 3097 patent families from Derwent World Patent Index

We devise thesauri of identified terms (e.g., technical topics, actors) and text mining mechanisms to extract nearby phrases. This blend of semantic and syntactic analyses may help mark and analyse development progression. We illustrate by representing temporal change patterns for topical emergence and for leading actor engagement and networking.

Results

We have applied FIP to several NESTs to various degrees, including nanobiosensors, deep brain stimulation, and nano-enhanced solar cells. The paper pursues Future-oriented Technology Analysis (FTA) results pertaining to dye sensitized solar cell (DSSC) development.

DSSCs reflect a variety of component technologies, with R&D emphases distributed among them. In one stream of exploration, we are exploring the intersection of advanced dye formulations (to enhance light energy capture) and semiconductor material advances (to improve conversion to usable electrical energy). Through basic text mining and semantic/syntactic analyses, we are working to identify interesting combinations. Once identified, we then pursue actor analyses and temporal change analyses to identify key players and development emphases.

Sorting through technical terms is challenging, but is benefiting from expert inputs. We are working to incorporate such details into our cross-charting procedures to elucidate which key players (countries and institutions) are pursuing which priorities. That, in turn, should help array strong candidate innovation pathways.

Implications

This paper extends our Forecasting Innovation Pathways approach.[4,5] Earlier papers suggested ways that particular FTA techniques can contribute to the FIP steps. We are still refining the approach as we try it out on NEST cases. The variability among NEST situations and possible decision needs calls for the FIP approach to be considered as very flexible. The extent of data available, time horizon for innovation, and scope of study all reinforce the need

to adapt these 10 steps to one's priorities. We hope that our FIP approach promotes the use of multiple information resources in conjunction with expert opinion.

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COMBINING QUANTITATIVE AND QUALITATIVE IN FTA: REDISCOVERY OR SOMETHING NEW?

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Keywords: Foresight, FTA, Methods, Qualitative, Quantitative, combining methods.

Introduction

FTA is said to provide a common umbrella for the foresight, forecasting and technology assessment research techniques and their respective communities. The direct reference to 'research techniques' lays the field open to being one in which every situation is approached through an enforced search for techniques to fit perceptions of the work in hand. However, Wittgenstein's dictum that 'methods pass the problem by' needs to be constantly in mind to prevent any FTA becoming simply an exercise in technique manipulation that prevents any useful outcome. In reality FTA needs to be a multi-themed hybrid that accommodates whatever principles and mind-sets that are needed by the work in hand; it is suggested that happens already by default.

FTA's future orientation means that it deals with matters characterized by uncertainty and ignorance. To embrace these characteristics FTA's premises and principles draw on what are commonly believed to be the metaphors from foresight, forecasting and technology assessment all of which have a long history and an equally long and growing catalogue of techniques to use in any FTA project. However, these agreed metaphors are often construed as theory while a parallel search for a philosophical cum theoretical basis to underlie FTA are pursued outside the cohort of practitioners. None of these feature overtly in the evolution of FTA even though each and every application makes assumptions about the underlying validity of the processes used. Indeed it is questionable whether any purpose is served by deferring to notions of philosophy and theory in a field where practical outcomes based on learning, thought and numeracy are what matter. However, the practical outcomes are themselves underlain by complex matters relating to human behaviour, uncertainty and ignorance that are generally subsumed under the title of subjective opinion in many dimensions; this will be the focus of this paper.

FTA assumes that its processes have an innate capability to deal with dynamic situations made up of many interconnected themes, each of which is characterized by behavioural traits, uncertain opinions and ignorance. FTA's principles must then embrace both quantitative and qualitative information, the latter in the form of subjective opinion. While the focus of FTA is essentially technology its purpose should be to set technology in the context of socio-economic matters, ecology, politics and human values/norms. Quantitative data, before its transformation into information, then plays a role in

conjunction with the other five constituents that frame the context of any FTA. Much of the perceived 'certainties' of quantitative information are arise from and are fraught with the uncertainty of expertise that needs to embrace substantive knowledge, assessing ability (required to enable interpreting substantive knowledge into the future) and imagination; a brief taxonomy of quantitative techniques is developed in relation to their behavioural basis.

Methodology

In considering how subjective opinion invades many aspects of FTA the first step has to be one of clarification to distinguish between different interpretations of probability based on individuals. The interpretations are objectivistic (frequentist), personalistic (with regard to propositions) and necessary (measurement of the extent that a set of propositions 'of necessity' confirms the truth of another) forms of probability. These interpretations of probability are often muddled greatly to the detriment of the discussion. Whilst these interpretations of probability are based on individuals their aggregation is possible in some circumstances provided it is remembered that each individual's opinion is itself a distribution so that aggregation involves the joining of a set of individual probability distributions. Because of the way these individual opinions are uncovered subjective probability distributions are not frequentist in the conventional sense, but are based on elicitation procedures that are common in risk analysis. Further clarification is needed to remove the confusion that reigns over the use of the notions of possibility, plausibility and reality. If something is transferred from conceptual to perceptual space it becomes possible as a mental construct that may remain at a negligible probability for an indeterminate period of time; this is the basic condition that underlies the notions of 'over-the-horizon' scanning, a necessary precursor to any FTA to achieve its future orientation. Plausibility is a matter of belief, assessed through probability that has its own distribution. Reality is the recognition of the matter or event in physical space, and will be preceded by its possibility even if it is not recognized until after the event (in which case it might be called potential possibility as recognition of the reality is subliminal and due to ignorance).

Results and policy impact/implications

With the foregoing matters in mind the paper will discuss how expert quantitative and qualitative information may be joined coherently, as is required by product and policy development, illustrating this from examples spread over many decades. The paper will suggest conceptual frameworks to develop understanding systems and situations in time and space through people's perception of objective reality; to develop methodological approaches by capturing the uniqueness of systems and their contexts through observation of objective reality; to improve practices with conceptual modelling through the personalistic construction of objective reality; to develop policies and put them in practice to influence situations in desirable directions.

Conclusions

Throughout it will be emphasized FTA cannot deal with ignorance in any form, but that the presence of ignorance needs to be constantly in mind enabling any FTA to be framed and managed in its perceived context. Future directions for the evolution of FTA and its methods will also be discussed together with their implications for the practice of FTA

CROSSCUTTING SESSIONS:
HORIZON SCANNING, GOVERNANCE,
HEALTH AND ENERGY

ON CONCEPTS AND METHODS IN HORIZON SCANNING: LESSONS FROM INITIATING POLICY DIALOGUES ON EMERGING ISSUES

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Keywords: Early warning, emerging issue, horizon scanning, weak signal.

Introduction

To better prepare policy and decision makers for new and future opportunities and threats, foresight and other Future-Oriented Technology Analysis (FTA) methods are often used to engage stakeholders in discussions that support the formulation of policy agendas. It is increasingly recognized that further efforts are needed for sound combination of available FTA methods that sometimes have strikingly different underlying premises and different communities of practice. There is a need for systematic mapping and use of horizon scanning techniques that requires also a solid conceptual framework. This paper draws on the experiences from the European FP7 horizon scanning project 'Scanning for Emerging Science and Technology Issues (SESTI)', in which the authors developed an approach that deals with how to organise and implement horizon scanning processes effectively to integrate diverse information needs of policy-makers on emerging issues.

Methodology

The paper describes a conceptual framework that clarifies, for instance, the use of different concepts such as (weak) early warning signals, wild cards, trends, hypes and emerging

issues. Building on the conceptual work, novel systematic exploratory and issue centred scanning approaches have been developed.

Different scanning methods (manual scanning based on the experiences of national horizon scans and joint online work by use of social networking combined with text-mining of web based sources, for instance) were applied to identify emerging issues. The identified issues were further discussed with experts and policy-makers in view of considering their possible impacts on the formulation of policy agendas, in particular in the fields of cognitive enhancement, energy and health.

Our analysis covers the comparison of efficiency, effectiveness and appropriateness of different approaches and methods. A specific evaluation framework is applied, addressing the above criteria drawing upon the needs of both scanning practitioners as well as policy and decision makers for information about emerging issues. Particular attention is devoted to (hidden) interests and agendas of different stakeholders who may try to influence their dissemination.

Results and policy impact/implications

The analysis will identify the advantages and disadvantages of the different scanning approaches and techniques in relation to efficiency, effectiveness and appropriateness for addressing the needs of practitioners as well as decision and policy makers. Additionally, difficulties will be identified in combining the methods and alternative ways will be elaborated of taking advantage of all of them in horizon scanning activities in best meeting the information needs of policy and decision makers.

Furthermore, we explore the possible role and involvement of decision-makers to be ready to act upon the findings of the scanning: What kind of evidence on signals and emerging issues can be presented and in what format? In how far can decision-makers and other stakeholders be engaged in the scanning itself to strengthen the commitment to the findings and what are the most suitable approaches to do that? In this respect, the paper suggests that the selection of the best combination of scanning methods and approaches for policy engagement is subject to contextual issues such as objectives, capacities, resources, organisational culture and timeline as well as content issues like the potential risks and urgency around the topic examined, depth and width of implications, public awareness and concerns.

Conclusions

Drawing on the experiences from the European FP7 horizon scanning project 'Scanning for Emerging Science and Technology Issues (SESTI)' the authors describe an approach that deals with how to organise and implement exploratory and issue centred horizon scanning processes effectively to integrate diverse information needs of policy-makers on emerging issues.

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COMPLEXITY SCIENCE APPROACHES TO DISRUPTIVE EVENTS

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Keywords:

Complexity theory, complex adaptive systems, interactions, emergence, policy making, reframing, neuroscience.

Introduction

Futures techniques are highly pragmatic and have been developed for use initially in commercial organisations but with little theoretical underpinning or support. In particular, there has been little work, or understanding on how to actively apply (implement) the results of futures projects. Much futures work, whilst very interesting and great fun to discuss over dinner, goes unused, unappreciated, and makes little observable difference. Complexity theory and some recent neuroscience can provide an underpinning theory for foresight and, most importantly, provide new insights into methods for *applying* futures to lead to better decision making and policy making.

Methodology

A review of selected aspects of complexity theory and exploration of the implications of these aspects for futures techniques, including some new insights. Examination of recent work on the inhibitory nature of the two halves of the brain and exploration of how this understanding can lead to improved futures work and in particular its application.

Results and policy impact/implications

Assuming that disruptive events can be managed by planning & forecasting is not a workable option. Instead, policies need to assume that disruptive events will happen, and will be unexpected, even with the best horizon scanning system in place. Policy development must take account of methods to work with, and within, complex systems as well as the different ways in which the brain interprets the world. One particular implication of complexity science for

futures, the importance of variation, is examined in detail to elucidate the specific policy making implications, which include the design and use a mix of policy instruments to achieve a single policy objective, removing the barriers that hinder the adoption of these strategies, and seeing and making linkages with other policies that have similar intent, understanding the resources or skill-sets required for the deployment of each of these alternative strategies and facilitating adoption and deployment of these strategies through appropriate policies to minimize risks.

Conclusions

Command and control type approaches to policy making do not work well in complex systems. The key conclusion for policy makers is that a system cannot be controlled from above –policy operating in a complex system cannot achieve a specific outcome. Instead policymaking needs to harness complexity– to deliberately change the *structure* of a system in order to increase the relevant measure of performance, and to do so by exploiting an understanding that the system itself is complex. Policy makers need to watch for, and where possible exploit, the *emergent* properties that arise as a system organises itself, and use policy to preserve the conditions in which the best solutions arise.

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FACING THE FUTURE: SCANNING, SYNTHESIZING AND SENSE-MAKING IN HORIZON SCANNING

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Introduction

Due to the increasing complexity of modern societies, policy-making institutions face growing challenges when seeking to address emerging issues in a timely manner. This is particularly true in policy contexts where the issues are not yet prominent on the policy agenda and where the requisite actions must be implemented early on to ensure success.

In such contexts, various forms of horizon scanning offer tested approaches for identifying signals that are portenders of emerging issues. Yet, the mere listing of such signals does not necessarily support the formulation of policy issues or, more broadly, the development of coherent policy themes which can be tackled through systemic policies that span several areas of administrative responsibility.

In general, horizon scanning activities for the shaping of systemic policies involve key questions such as: i) how to facilitate the recognition of signals and the elaboration of corresponding policy issues?; ii) how to synthesize such signals and issues into meaningful theme clusters?; and iii) how to facilitate collective sense-making in the analysis of such theme clusters, in recognition of the "big picture" of societal change that sets the stage for the development of policy recommendations?

Methodology

In this paper, we address these three questions in the light of the horizon scanning and foresight exercise "Facing the Future: Time for the EU to Meet Global Challenges" which was

carried out in 2009 by the Joint Research Centre (JRC) - Institute for Prospective Technological Studies for the Bureau of European Policy Advisors (BEPA) of the European Commission (EC). Specifically, this exercise offered fresh perspectives for EC policy-makers by combining several methodologies. For example, an extensive analytical review of recent future oriented studies was carried out to distill issues which were assessed by 270 experts in an online consultation. Then, a multi-criteria decision analysis (MCDA) method entitled Robust Portfolio Modeling (RPM) was employed to facilitate the identification of issues that were seen to merit particular attention. Moreover, the issues were aggregated to formulate theme clusters which were discussed at length in a workshop with selected experts and EC policy-makers.

By describing the overall methodology and its uses in fostering policy impacts, this paper sheds light on the alternative uses of MCDA in horizon scanning activities. For example, the explication of multiple criteria brought new perspectives into the analysis and synthesis of issues; however, it also raised questions concerning how the different criteria – such as novelty, relevance and probability – should be weighted. Here, one of the reasons for adopting the RPM approach was that this methodology explicitly admits incomplete information about criterion weights and, by doing so, accommodates different interpretations about which criterion weights are plausible.

Furthermore, the exercise involved creative and collaborative activities where the experts were invited to synthesize issues into cross-cutting clusters of themes. The aim of these activities was to produce encompassing entities which would be easier to make sense of and which would thus facilitate collective reflection and sense-making. While these activities were reasonably successful, they also pointed to inherent tensions in such endeavours. For instance, the enormous number of different combinations of issues implies that any such synthesis has to be partly based on heuristic sense-making, because it is practically impossible to explore exhaustively all combinations. Another tension pertains to the ability to formulate cross-cutting clusters of themes that suggest implementable policy actions. That is, while such clusters can, at best, be communicated by way of evocative narratives, they may appear somewhat superficial, because they may not exhibit the same level of rich detail as individual issues. Moreover, if the clusters of themes involve several 'administrative silos', there is a potential complication of formulating policy actions that transcend prevailing boundaries of institutional responsibilities.

Results and policy impact/implications

The substantive results of the exercise have supported the strategy work of BEPA and JRC as well as the planning activities of the stakeholders who participated in the exercise. For example, the results have served as one of the inputs for shaping the vision for the EU in 2020 and the EC Communication on the Innovation Union.

Conclusions

The European foresight exercise "Facing the Future" described in this paper highlights just how pivotal collective sense-making processes are in horizon scanning. Indeed, these processes underlie the identification of policy issues that are deemed as relevant; the synthesis of such

issues into encompassing theme clusters; and the interpretation of these resulting clusters in terms of policy implications. These inherently subjective processes can benefit considerably from adequate methodological support, such as the use of multi-criteria decision analysis for prioritizing issues or the running of collaborative workshops for synthesizing them to shape policy recommendations as part of a sense-making process in horizon scanning.

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WILD CARDS AND WEAK SIGNALS INFORMING AND SHAPING THE EUROPEAN RESEARCH AREA (ERA)

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Keywords: wild cards, weak signals, horizon scanning, foresight, risks, ERA, science, technology, innovation, policy.

Introduction

This publication is based on preliminary findings of the iKnow research and technology development (RTD) project. iKnow aims to advance knowledge and the state-of-the-art in foresight and horizon scanning approaches to events and developments potentially shaping or shaking the future of science, technology and innovation (STI) in Europe and the world. To do so, iKnow is primarily (but not only!) concerned with *wild cards* and *weak signals*. **Wild Cards** are situations of very low 'perceived probability' and very high potential impact. They can be classified into three categories: *nature-related events* (e.g. the magnitude 9.0 earthquake in Japan on 11 March 2011); *unintentional consequences of human actions* (such as the 2011 "radioactive disaster" in Japan, due to decisions to build nuclear facilities capable of withstanding up to 7.0 earthquakes in areas of significant seismic activity); and *intended consequences of human actions* (e.g. 9/11 or WikiLeaks release of thousands of US diplomatic cables in November 2010). **Weak Signals** are past or current developments/issues with (quite often) multiple interpretations of their origin, meaning or implications. They are unclear observables warning us about the probability of future events, including wild cards. Weak signals lie in the eye of the observer, thus practically anything could be interpreted as a weak signal, including *strengths and weaknesses* (e.g. failure of social care systems in educating young people); *drivers, trends and challenges* (e.g. increasing self-medication); *strategies and policies* (e.g. growing privatisation of war; cars banned from city centres); *emerging issues* (e.g. care communities, US university offering Lady Gaga sociology course); *scenarios, threats and opportunities* (e.g. Obama's goal of one million e-cars on US streets by 2015); *shared visions, megatrends and Grand Challenges* (e.g. growing frequency of floods in Europe and the world); *hidden issues* including secrets and "unknowns" (e.g. several Arab leaders urging US to attack Iran) and *past wild cards* (e.g. 9/11 has suggested that terrorists could have infiltrated US security circles). Finding "relevant" weak signals is one of the most challenging tasks in futures research and their analysis often leads to the identification of potential Wild Cards.

Methodology

iKnow combines *horizon scanning* and *foresight* to inform *research and technology development (RTD) policy*, particularly in the European Research Area (ERA).

- Horizon Scanning is a systematic and strategic process of identification, assessment and (sometimes) management of (commonly) uncertain issues (including emerging issues, weak signals, prototype/experimental technologies, growing concerns and research agendas), which may potentially develop into (missed) opportunities, threats, Grand Challenges, megatrends or wild cards, depending on their 'perceived probability' of occurrence and type of impacts.

- *Foresight is a systematic, participatory, prospective and policy-oriented process*, which, with the support of environmental/horizon scanning approaches, is aimed to actively engage a wide range of stakeholders into the joint exploration, design and shaping of technological, economic, environmental, political, social and ethics/values-related (TEEPSE) futures. In so doing, Foresight involves the interconnection, generation and evaluation of knowledge gathered and produced in a SMART process, consisting of: *Scoping*, *Mobilising*, *Anticipating*, *Recommending* and *Transforming*.

Overall, iKNOW has mixed (1) *evidence-based approaches* (literature reviews, environmental scanning, and horizon scanning); (2) *creativity-based approaches (*wild cards and weak signals analysis, science fictioning and essay/briefs/scenario writing); (3) *expertise-based approaches* (70+ interviews, expert panels and Delphi surveys); and (4) *interaction-based* approaches (via web 2.0 platforms, four national workshops and an international conference).

Results and policy impact/implications

iKnow developed new concepts and tools to identify and analyse 400+ Wild Cards and 300+ Weak Signals. From these 700+ results, we have selected 120 issues related to 12 thematic areas: health; agriculture; energy; environment; transport; social sciences and humanities; space; security; nuclear; and R&D capacities. Around 400 experts assessed these 120 issues in Delphi survey and key policy impacts and implications are identified and described in this paper.

Conclusions

This paper demonstrates that it is not only possible but also necessary to use wild cards and weak signals analysis to inform and shape RTD policy in the European Research Area (ERA).

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The Impact of Foresight and Forward Looking Activities in the Governance of Emerging Technologies: The Case of Nanotechnology

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Keywords: Governance, Emerging Technologies, Nanotechnology, Foresight, Technology Assessment.

Introduction

The emerging technologies of the last decades - such as nanotechnology – were seen as means to archive a variety of goals linked with broader future needs and expectations that are framed today as major grand challenges. In the case of nanotechnology the direction of innovation and its implications were especially highly uncertain when the first national nanotechnology programs were established in the 1990th.

The aim of this paper is to show in a first step which problems/challenges in regard to the innovation system were addressed and which actors were mainly involved in the future oriented exercises that were conducted prior to the establishment of national nanotechnology programs. In the second step the paper will show how goals of sustainability came on the agenda and which role different future-oriented technology analysis played in different countries.

In many countries FTAs and forward looking exercises were part of early governance processes that determined how different goals (economic growth, strengthen competitive and location-specific advantages, innovation towards sustainability) were related and linked, and how nanotechnology was conceptualized to lead to innovations towards responding to sustainability as a global challenge.

Methodology

Methodological approach: Analyzing the impact of different types of FTAs and Foresight exercises in different countries in regard to the governance of nanotechnology.

The paper will focus on four different cases, analysing what kind of FTAs were be used to shape the technology field (in the early stages) and to influence the national innovation systems (implementing nanotechnology programs in later stages). There are two main dimensions

that are crucial for the specific impact of FTAs and FLAs in the four different countries: The interrelated dimensions of timing and involved actors.

Results and policy impact/implications

The first case is Germany where different FTAs used for shaping and defining research and innovation agendas in different stages. Germany is among the top countries regarding R&D spending and output indicators (publications and patent applications) worldwide and the German government implemented funding programs on nanotechnology in the 90th, using in advance different kind of forward-looking activities to identify the different promising areas of the field, to define the field, and to assess the market potentials of future nano-applications.

The second case is US, were FTAs were used to address visionary concepts. One example for 'latecomer' is the case of Denmark, facing the situation of acting in an international environment of established funding programs, confronted with the situation that the field was already well defined and stakeholders of large countries has already defined their research agendas. On the other hand they integrated the development of nanotechnology in a broader context of addressing sustainability issues based on an international discussion on the potential of nanotechnologies and nanosciences for sustainability goals. The fourth case is the Russian case, were an ambitious nanotechnology initiative became federal law in 2007.

Conclusions

It will be shown, how timing and the involvement of actors (as well as the absence of actors) have specific impact to archive different goals and challenges addressed.

FORESIGHT AND POLICY MODELLING ON ICT FOR GOVERNANCE: EXPLORING THE NEXT FRONTIERS

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Introduction

Today, society and the economy are more interconnected, unstable, and unpredictable than ever. Furthermore, developments in Information and Communication Technologies (ICT) are happening at a very fast pace. Current policymaking strategies and also the ways of procuring supporting evidence for policy decision making are no longer able to cope with complex, multidimensional and highly dynamic societal challenges. For more than 60 years, society has largely failed to eradicate critical social challenges despite investing increasing resources into state policy activity [Ormerod, 2010]. It appears that *policy resistance* is responsible for these failures [Sterman, 2006]. However, we now have at our disposal a radical increase in computing power along with outstandingly widespread distribution of networked communities. The possibility of collecting and processing huge amounts of data at moderate costs was unthinkable only a decade ago. These developments have led to the emergence of futuristic visions, such as 'singularity' which suggests that computers will exceed human cognitive capabilities and an 'intelligence explosion' which could, among other things, prolong and improve quality of life [Kurzweil, 2005]. However, current tools and approaches for policy design, implementation and evaluation are ill-suited to capturing this complex and interconnected future. Moreover, they are based on an abstract and unrealistic vision of the human being: rational (utility maximising), average (not heterogeneous), atomized (not connected), wise (thinking long-term), often highly

simplified (complexity denial) and politically committed [Piniewski, Codagnone and Osimo, 2011 forthcoming].

Methodology

This paper is partly based on the results of the research carried out by CROSSROAD, an FP7 Support Action to design the Future Research Roadmap in the domain of ICT for governance and policy modelling. This Action aimed to provide strategic directions and define a shared vision, able to inspire collaborative, interdisciplinary and multi-stakeholder research. In this context, a participatory foresight exercise was conducted, which outlined a set of scenarios on how governance and policy modelling, enhanced by the use of ICT, could develop by 2030. The scenarios were developed by means of narration of possible future outcomes in selected key areas of European society where ICT tools for governance and policy modelling could have a major impact. The scenarios, and their formulation and interpretation, expose current gaps in research and indicate what needs to be done today to enable better governance and construct a more open, innovative and inclusive digital Europe tomorrow.

Results and policy impact/implications

The paper presents the results of the foresight exercise based on scenario design conducted by the Information Society Unit of IPTS. This exercise aimed to explore possible alternative futures in ICT for governance and policy modelling research and to elaborate on the possible impacts that future mainstreaming of ICT tools in this domain could have. The paper thus draws a framework for analysis of current and future challenges in ICT for governance and policy modelling and of the resulting implications for citizens, business and public services. The paper builds on the findings of this research activity, which links diverse research disciplines with practitioners' views and policy makers' concerns through a multi-stakeholder and participatory approach, and highlights some of the paradoxes of current ICT-enabled societal modelling efforts. It also addresses the issues of measurement of the Information Society. In doing so, the paper attempts to link foresight techniques with policy modelling approaches and to assess their implications for the future Digital Europe 2030.

Conclusions

The paper concludes with a presentation of the policy and research challenges that policy makers will be confronted with in implementing the *Digital Agenda for Europe,* which aims to increase the EU's growth and competitiveness in the fast-evolving global landscape, and address today's grand challenges. 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 of complex, globalised issues and their possible solutions. This paper discusses how integrating the envisioning of future scenarios through foresight with forecasting possible impacts on society through modelling and simulation can constitute a building block for next generation policy-making.

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STRATEGIC DIALOGUES FOR RESEARCH POLICY MAKING IN GERMANY

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Keywords: Strategic Dialogue, stakeholder involvement, research policy making, dialogue process, Foresight, BMBF, Hightech Strategy.

Introduction

The German Federal Ministry of Education and Research (BMBF) conducts Foresight and related strategy processes to support research policy development. In addition, a number of other activities are oriented towards identifying and analysing areas for future research and technology, including some that use a mission-oriented approach within the framework of societal needs defined by the so-called Hightech Strategy.

The success and impact of these activities on the innovation system depend on the participation of stakeholders inside the BMBF and other federal ministries as well as in academia, industry and society. We present results of stakeholder involvement through so-called "Strategic Dialogues" both during the process of creating consensus views of future developments and during their translation into research policy.

Methodology

Strategic Dialogues aim for a planned and structured involvement of stakeholders using a combination of tools such as semi-structured interviews and various workshop formats supported by online tools. Key success factors include (1) a careful selection and engagement of stakeholders considering their potential contribution, their role in developing research policy, and their commitment to future activities; (2) consideration of the existing structure of departments within the Ministry as well as known difficulties in initiating activities across departments; (3) ensuring relevance and a joint understanding through appropriate presentation and transfer of results from Foresight and related strategy processes; (4) compatibility with existing strategic planning activities in individual units within the BMBF.

Strategic Dialogues are tailored to the subject matter as well as the relevant stakeholders according to their needs. However, there are recurring elements in the context of research policy development where a Strategic Dialogue is typically initiated by a BMBF unit concerned

with strategic issues. At the outset, a rough scope is agreed, and BMBF units whose specialist areas overlap with this scope are identified and join the process. A second step is the generation of a joint understanding between BMBF units on the thematic content and the goals of the Strategic Dialogue, where goals can be specific to individual units and tie in with their own agendas. A possible third step is to generate a pragmatic overview of earlier funding activities, nationally and internationally, as well as the identification of action areas. This may include dialogue elements to ensure involvement and commitment of the relevant research community as well as federal ministries other than the BMBF.

On this basis, the roles and modes of collaboration between BMBF units as well as with external stakeholders are defined. The Strategic Dialogue results in a generation and translation of a joint view of the future into prerequisites and recommendations for a coherent research policy and its implementation through programs and/or dedicated institutional structures.

Results and policy impact/implications

Strategic Dialogues were e.g. conducted for focus areas from the latest BMBF-Foresight process, an overview of which is given in a conference paper by Warnke et al. For the focus area "ProduzierenKonsumieren 2.0" (ProductionConsumption 2.0), the strategic dialogue involved seven organisational units within the BMBF drawn from the full range of BMBF departments concerned with research policy. In addition, contact with three other German federal ministries was established. – In the first phase, the results of the Foresight process were reframed to pinpoint their relevance to each of the BMBF units and to crystallize a joint understanding of "ProduzierenKonsumieren 2.0". – In a second step, a survey of previous funding programmes showed a need for initiatives to exploit the potential of "ProduzierenKonsumieren 2.0" and the need to involve communities in academia, industry and society in identifying practical steps towards addressing the situation. – This wider involvement is currently in progress in phase 3 of the Strategic Dialogue and is supported by all stakeholders in the BMBF.

Another Strategic Dialogue was conducted for a so-called Forward-looking Project in the framework of the Hightech-Strategy. Forward-looking Projects are designed to map out scientific and technological developments over a period of 10 to 15 years in specific areas, and to communicate them to a wide audience. - The Strategic Dialogue resulted in a pragmatic vision for a "CO_2-neutral, energy-efficient and climate-adapted city" that was developed in a scenario workshop with a cross-disciplinary panel of 20 experts. Drawing on their assessments of potential economic, social and technological developments, a coherent vision was created that is now a key element for communicating the Forward-looking Project in the media and for involving the public.

A third example of a successful Strategic Dialogue is the definition of a novel type of innovation cluster across academia and industry. A range of views on numerous aspects of co-operation models was collected from selected stakeholders and researched internationally. Key issues were crystallised in a dialogue process with the BMBF and then addressed in a tightly structured workshop with about 35 experts. The resulting outline of a possible new type of innovation cluster has proved to be stable throughout further discussions in various policy-making contexts.

Conclusions

Strategic Dialogues have proved to be an effective and efficient instrument for achieving the transfer of results from strategic processes such as Foresight into research policy making. They trigger and facilitate opinion forming processes within political institutions and involve other relevant stakeholders in a wide-ranging dialogue to deal with societal challenges.

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MAPPING OF FUTURE TECHNOLOGY THEMES IN SUSTAINABLE ENERGY

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Introduction

Low carbon society and sustainable energy is one of the grand challenges to humankind and attracts great international attention. Searching for niches within world-wide technology trends of sustainable energy where Taiwan could design an appropriate strategy and get a special opportunity to a leading position in the mid- to long- term becomes a main task for a medium size country like Taiwan. This paper is related to the use of horizon scanning to identify the future trends in sustainable energy and the results and experiences from the practice.

Methodology

For mapping of future technology themes in sustainable energy, our research conducted horizon scanning for Delphi topics in energy fields originated from Japan, South Korea and China foresight reports and these themes were mapped against internationally accepted technological field classification cluster based on WIPO patent classification system through text analysis, and further, the originated/targeted use of technological fields for these future technology themes were identified through causal analysis and the linkage or interaction there between can be aggregated and compared .

Results and policy impact/implications

The mapping results can be utilized by policy makers and foresight practitioners as a strategic intelligence to identify the possible trends and opportunities in a systemic way. The analysis provides a more holistic view of future technology development in sustainable energy and the tendency of interactions among these future technologies. Based on analysis of important technology themes derived from these countries, vision difference in technology development was also identified. Therefore, the mapping result provides much more comprehensive

information for designing specific science and technology strategy for Taiwan, upon concerning the historical context in technology cooperation or competition.

Conclusions

According to the mapping result in our research, a horizon scanning for future technology themes can be easily conducted and analyzed through a standard patent classification system. It may help to solve the practical difficulties faced during the secondary analysis of foresight studies from different countries/regions during the foresight preparatory studies by providing a consistent classification framework, and the mapping results can be easily aggregated and demonstrated in a holistic view. Also, after identification of a number of future technology trends, this classification system further provides the linkage of comparison with current technology strengths like patent productivity.

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BACKCASTING SCENARIOS FOR FINLAND 2050 OF LOW EMISSIONS

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Keywords: backcasting scenarios, Delphi study, government foresight report, climate and energy policy

Introduction

 The aim of the scenario task for the Finnish government's futures report on climate and energy policy was to map out the processes that enable the achievement of a climatically sustainable emission level while retaining the current standard of living. Those involved in the scenario process were largely unanimous regarding the sentiment that the desired development, which would combine these two goals, could be achieved, provided that the existing welfare indicators are redefined and current procedures and technologies are further developed.

Methodology

Four separate scenarios with a common goal reaching to the year 2050 were constructed: Scenario A Efficiency Revolution, Scenario B Sustainable Daily Mile, Scenario C Be self-sufficient and Scenario D Technology is the Key. The background factors linking these scenarios were: significant progress in the renewable energy source technologies, considerable improvements in energy-efficient housing, a shift to a service-based economy, and thereof a relative downsizing of heavy industry. The four scenarios were constructed by using the backcasting approach, looking back to the present from the future state of 2050. For the purpose of constructing the scenarios and commenting on them, a Delphi study with two rounds was also conducted. The paths to the future in all four scenarios were presumed to fulfil the objective of no more than two degree Celsius of global warming as defined by the EU climate and energy strategy, as well as to achieve the expected cuts in GHG emissions.

Results and policy implications

A recurring theme amongst the experts heard during this government foresight process was sustainable urban and housing planning. The decisions made in these two areas have long-term consequences and affect energy consumption and emissions in many ways. The scenarios were aimed at helping define the measures required in Finland to reach the emissions cuts, as well as to assess the strengths and weaknesses of various alternative measures to reduce emissions. Some of the means of achieving the climate objectives fall within government's responsibility (e.g. climate taxes), whereas other measures depend on the activity of individual actors (e.g. the development of more efficient logistic processes and services). As a principle for the climate and energy policy, the government should create clear and credible rules that support the actualisation of the policy and set the boundaries for companies to plan their future investments. Failing at that, the actors may be tempted to hold on to traditional technologies and procedures.

Conclusions

The foresight report on climate and energy policy, which these scenarios are a part of, was accepted by the government of Finland in October 2009 and submitted to Parliament. The external and internal evaluation of the foresight process of the government's futures report and its scenario work was an interesting continuation. Thus the usability of this kind of foresight work in policy planning could be enhanced.

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A Technology Opportunities Analysis Model: Applied to Dye-Sensitized Solar Cells for China

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Keywords: Technology opportunity analysis, patent analysis, dye-sensitized solar cell

Introduction

Identification of technological opportunity contributes to the success or failure of technological innovation management. The development of high-level technology in China and the other large developing countries is characterized as "fast-following." This role places a premium on carefully assessing technology innovation opportunities to face global competition. To address this need, I propose an emerging technology opportunity analysis model (Porter and Detampel, 1995) for developing countries. The model draws especially on patent analysis, augmented by expert opinion, to anticipate and identify technology development opportunities and challenges for technology innovation.

Methodology

In this research, we devise an opportunity analysis model to find a niche space for the technology development of Dye-Sensitized Solar Cells (DSSCs) in China. Patent data from the Derwent World Patents Index (DWPI) were used to explore DSSCs technology development and its trends.

This article introduces four levels of analysis:

- R&D analysis—trying to find some new or valuable research topics through technology morphological analysis based on keywords (Yoon and Park).
  In this model, DSSCs technology is treated as a system that is composed of a number of subsystems, wherein each subsystem can be shaped in a number of different ways. Any technical change of subsystem may advance the whole technology system. Based on the

principle, a systematic methodology is devised to obtain the various technical keywords from patents for each subsystem. The further keyword-based morphological analysis combined with the support of expert opinion is designed to discern 1) what's the leading or the most potential technology for each subsystem; 2) Who (countries) focus on what technologies in these subsystems; and 3) which is more easier to going to a product.

- Competitive analysis—recognizing contemporary/potential competitors and profiling their development trend and research strengths; meanwhile exploring collaboration opportunities for China.
  In this model, top assignees analysis is introduced to recognize the contemporary competitors, while active assignees analysis helps to recognize the potential competitors. This section aims to find out 1) who (organization) are strong or active in specific subfield; 2) which assignees of China are most potential to anticipate in global competition; and 3) if any national or international collaboration opportunities present themselves for those potential assignees.
- Market analysis—generating insight and understanding on the contemporary market. Forecast the potential market by the distribution of family patents in order to identify market opportunities.
- Strategy analysis—studying government S&T policy by searching government reports and Internet information to explore the most potential application for China.

This yields a multi-angle model for profiling an emerging technology of interest. In addition to framing the analyses, the research provides an attractive way of summarizing critical intelligence about the focal technology.

Results and policy impact/implications

DSSCs have become the hot research topic because of their high conversion efficiency, low cost, and easy production as compared to other solar cells. These attributes render DSSCs a photovoltaic technology particularly well suited for Building Integrated Photovoltaic (BIPV) applications and for electrification in developing countries. We apply the technology opportunity analysis model to explore China's opportunities in DSSCs. The empirical analysis shows that China has demonstrated a sharp growth in DSSCs since 2006 and faced significant challenges, but notable opportunities are foreseeable. China's DSSCs R&D activities mainly take place in academic institutions and universities, led by Chinese Academic of Sciences (CAS). The major opportunity lies in continuously seeking and producing new, practical, and efficient organic dyes to reduce cost and improve the stability of DSSCs. China now mainly focuses on the national market. A few Taiwanese corporations could potentially develop an international market. Japan is the biggest competitor but also a potential partner. The most important potential application for China is to supply power for the needs of remote countryside locations. Seeking international collaboration and enhancing industrialization by strengthening the linkage between universities/ institutes and other measures present major challenges for China.

Conclusions

The empirical case analysis supports the effectiveness of the technology opportunity analysis model. The model supports opportunity analysis from multiple angles. Keyword-based morphological analysis remedies the weakness of conventional bibliometric analysis when it enters into analysis at the micro-level. We believe it can adapt well to other emerging technologies.

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LINKING FORESIGHT TO ACTION:
A HEALTH CASE STUDY

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Key words: Foresight, Decision Making, Health, Science and Technology.

Introduction

Between December 2009 and March 2011, a major collaborative foresight initiative was undertaken by the Science and Technology Foresight Policy Division of Health Canada (a federal government department) and Alberta Innovates-Technology Futures (a provincially owned research institution). The project (referred to as the Health Foresight Initiative) involved the implementation of an iterative multi-faceted foresight process to gain new insights and understanding about science and technology investments that could be taken today, which would contribute to improving the health of Canadians in a single generation (to 2030).

Methodology

The Health Foresight Initiative was conceptualized and designed to overcome the challenges related to translating the knowledge and insights gained from foresight activities into tangible recommendations that result in actionable decisions. Key design considerations for linking foresight to action included: project leadership, design of the process, designing for engagement, designing for innovation and designing for communications

Results and Policy impact/implications

Three factors emerged as particularly significant during the Health Foresight Initiativive; (i) the need to broaden the definition of, and approach to, health and wellness, (ii) the need to recognize the individual as a full partner in maintaining health and wellness and (iii) the paramount role of

digital technologies in improving the health outcomes of Canadians.

Conclusions

This robust foresight project design fostered innovative new ideas and solution sets that are (at the time of writing) being communicated to broad audiences of health sector decision makers and stakeholders for consideration.

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TECHNOLOGY ACCEPTANCE OF HOME CARE SERVICE PROVIDERS

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Keywords: Technology Acceptance, Demographic Change, Elderly Care, AAL, Services.

Demographic change brings about a lot of challenges to most of the EU countries as the percentage of the elderly is rising disproportionally. The financial burden and the task to care for those elderly that will be impaired physically and mentally will have to be taken over by a decreasing share of young people. Single households – also among the elderly – are on the rise and working women are less and less willing and capable to fulfill home care of their older relatives. Only a combination of technological and social innovations paired with new public policies will be able to cope with these challenges, to guarantee the individual independence and dignity of the elderly and at the same time keep the costs of elderly care manageable. For technical innovation, the "Ambient Assisted Living" (AAL) programme at EU level and in various member states has generated some interesting solutions, offering the elderly the continuation of their own life style in their individual environment with optimal home care whenever needed. Most of these solutions still need to be implemented, though. New models of care and new services, including technical support services, will be needed as well. Quite some research has been going on concerned with these topics. What is missing, however, is a critical assessment of the future role of the home care service providers or caregivers.

We can see already that this role is changing. Home care service personnel, e.g. nurses, will become the major contact points, the nexus, between the elderly and the technology suppliers. Empirical research has shown that home care service providers are usually the first persons to be contacted by elderly people or their relatives when new technologies are to be acquired. The question arises, how service providers who are by definition not game for technologies accept the technical innovations at their work place and how they will integrate them into the workflow of elderly care at home.

The study to be presented is one of the first that deals with this question. We have looked at historical discussions of technology acceptance in general in society. We have also looked at studies of technology acceptance at the workplace, especially services, and approaching our

topic closer we have considered studies of technology acceptance in hospitals where more research has been done. Finally we have formulated hypotheses and designed an analytical framework to investigate the acceptance of AAL technologies among home care services.

Our research, which is not completed yet, has already shown that there are different categories that influence the technology acceptance of caregivers working at the patient's home. We will briefly explore those categories, criteria and their further implications in this paper:

Those categories can be structured into four clusters:

1. Personal criteria: Attitude towards (new) technologies

2. Technology-related criteria: Benefit of the new technology and usability of the technology

3. Societal criteria: Status attached to the technology

4. Work related criteria: Attitude towards changes at the work place

From our findings we conclude, for example, that caregivers working at the patient's home will find themselves increasingly in different roles: they are nurses, (sometimes the only) social companion, often the first (and only) contact point to the outside world of the patient, contact point for further and new services and technologies, advisor for purchasing new technologies, taking care of technologies and controlling them (and sometimes being controlled by them too). Finally, they might also become instructors for others as they have to explain the usage of new technologies to the people closer to the patient (relatives, neighbors).

The challenges the care sector is faced with presently and in the near future will change the profile and portfolio of the caregiver's activities. More activities will be added and more specialization will emerge for specific tasks, some of them related to new technologies. Further qualification and wages to be paid accordingly have to be responses to such developments. A lot of these issues have not been considered sufficiently yet, not at the sector level by health care organization, not by unions, and not at the policy level either.

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BETWEEN EXPECTATION AND UNCERTAINTY: FUTURES OF DIAGNOSTIC INSTRUMENTS FOR ALZHEIMER'S DISEASE IN OUR AGING SOCIETY

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Keywords: biomarkers, Alzheimer's disease, expectations, uncertainties, responsible innovation.

Introduction

Europe is facing the grand societal challenge of a rapidly aging society and the prevalence of Alzheimer's disease (AD) as an increasingly important phenomenon. This challenge has led to research programs developing diagnostic instruments for AD based on biomarkers, rather than symptoms. This type of diagnosis promises to create conditions (1) for a more reliable and earlier diagnosis (2) for effective evaluation of novel medication therapies of AD, and (3) to study the causes of AD at an earlier stage of the disease process. Scientific and clinical effort, as well as public funding is being invested in this type of research, focusing on development of imaging techniques (MRI, PET), and the analysis of Cerebrospinal Fluid (CSF).

The promises of early diagnostics of AD are predicated on a particular representation of the future. Yet, the mere announcement of early diagnostics of AD has already provoked a range of uncertainties to be articulated, such as concerning the role of insurance, clinical procedures, the definition of the disease and its patients. Will the improvement of these future instruments indeed lead to an earlier and more reliable diagnosis? What is the value of being diagnosed with AD for a patient, when treatment is lacking? Will it contribute to a solution to the societal problem?

In this paper we argue that there are more futures for diagnostic instruments for AD in an aging society, and not just one. We will trace these futures, analyze how they are produced by the interplay of expectations and uncertainties and how they suggest ways to productively relate to the futures of diagnosing AD.

Methodology

Methodologically, we follow three steps. First we analyze how the dynamics of expectations and the dynamics of uncertainties are conceptually related in the case of AD. Second, we provide a systematic overview of the current landscape of Alzheimer's in the Netherlands, including stakeholders, their interests and the recurrent issues in their interactions, especially concerning the efforts to realize early diagnosis of AD. This overview is based on desk research, site visits in clinics and nursing homes and interviews with researchers and policy makers. Finally, we study the discursive spaces provided by so-called Alzheimer Cafes (ACs), where persons with dementia and their relatives regularly meet to support each other in group meetings. This analysis is based on interviews, observations during support group meetings and document analysis.

Results and policy impact/implications

The development of early diagnostic instruments is surrounded by huge expectations and many uncertainties. Both expectations and uncertainties guide actions, provide legitimacy and set agendas for different stakeholders, thereby creating prospective structures and steering developments. Our study of the broader AD landscape shows the distinctiveness of the represented future that propels the efforts to develop early diagnostic instruments based on biomarkers. This future is definitely not the only one that is articulated or shared by actors in the AD landscape.

In our empirical study of discursive spaces we follow how actors in ACs discuss dementia with patients, family, informal care givers and local professionals. ACs provide an informal ambiance (hence the word 'café') to allow people to exchange experiences and talk openly about dementia. Since different stakeholders meet in this setting, we were able to trace different conceptualisations of AD, expectations, uncertainties and interests. Within the AC, for example, a diagnosis of the disease is more than a step in the process to treatment: it is both a verdict and a sense making tool. Early diagnosis is represented, then, as a means to help people making sense of what is happening to them (or their family member) and to deal with this in a deliberate way. Steps towards early diagnosis of AD in the future concern a.o, changing the attitudes of general practitioners in recognising dementia, and the reduction of the societal taboo and stigma on AD. Striving for early diagnosis entails more then measuring or imaging biomarkers in the brain, and biomarkers have a much less central position within these expectations. We conclude that the study of the discursive space provided by ACs provides a way to gain insight into the multitude of AD futures.

The existence of multiple futures regarding such a societally grave disease as AD has important policy implications. Foremost, it is important that policies contribute to responsible innovation by taking account of the multiple futures, and the concomitant articulated (and contested) expectations and uncertainties. Research and innovation policy should prevent an early lock-in into a specific represented future.

Conclusions

We conclude in two ways: an assessment of the desirability of the development of early diagnostic instruments, given the consequences of this promising research on the expectations and uncertainties of patients and relatives; an assessment of the discursive spaces of Alzheimer cafes and patient associations as platforms to deliberate the various futures of diagnostic instruments for an aging society in general and for AD in particular.

Abstract

Following the success of previous years, the International Seville Conference on Future-Oriented Technology Analysis (FTA) has become a major occasion for FTA experts, practitioners and decision-makers to bring their ideas and knowledge together in a highly interactive environment.

As with previous FTA events, the 2011 Conference places emphasis on diversity of views by attracting participants from a wide geographical base. Academics, practitioners as well as public and private sector decision makers from Europe, North America, Asia, Latin America, Africa and Australasia are invited to broaden the network and to increase understanding of advances in the field of FTA.

During the conference posters and papers will cover the following themes:
1. Orienting innovation systems towards global challenges and the roles that FTA can play
2. Building FTA capacities for systemic and structural transformations
3. Premises and practices in combining quantitative and qualitative FTA methods
4. Horizon Scanning, governance, energy, health

This book of abstract gives an overview of all the papers presented in the conference and will serve as a guide to the participants.

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