Technische Universität Dresden
Medienzentrum

Prof. Dr. Thomas Köhler
Dr. Nina Kahnwald
(Hrsg.)

GeNeMe '12

Gemeinschaften in Neuen Medien

an der
Technischen Universität Dresden

mit Unterstützung der

BPS Bildungsportal Sachsen GmbH
Campus M21
Communardo Software GmbH
Dresden International University
Gesellschaft der Freunde und Förderer der TU Dresden e.V.
Hochschule für Telekom Leipzig
IBM Deutschland
itsax - pludoni GmbH
Kontext E GmbH
Medienzentrum, TU Dresden
Webdesign Meier
SAP AG, SAP Research
T-Systems Multimedia Solutions GmbH

am 04. und 05. Oktober 2012 in Dresden

www.geneme.de
info@geneme.de

A Eingeladene Vorträge

A.1 The Role of Creativity in Cooperative Foresight Activities in Living Labs

Andrzej M.J. Skulimowski
Decision Science Laboratory, Chair of Automatic Control and Biomedical Engineering, AGH University of Science and Technology
International Centre for Decision Sciences and Forecasting, Progress & Business Foundation

Abstract

This paper presents the cooperative modelling methodology used in the Information Society foresight carried out within the research project SCETIST. The class of models here presented used the concept of group decision creativity that has been elaborated for the use in a Living Lab. The trends and scenarios are discussed and refined during cooperative activities, finally verified using the simulation of a hybrid system consisting of qualitative information processing, and a discrete-time-control system with a discrete-event component.

Keywords: Foresight, Collaborative Modelling, Computational Creativity, Living Labs, SWOTC Analysis, Complex System Modelling

1 Introduction

The challenging transition period accompanying the EU accession of the twelve EU New Member States (in the sequel: NMS) allowed to make a number of unique political, social, technological, and economical observations, touching upon the development of the Information Society (IS). The latter has been given a special attention because its development belongs to the priority goals of the EU cohesion policy. This, in turn, made possible to draw more general conclusions regarding the evolution of IS and its technologies.

The origin of some of the cooperative methods presented in this paper can be attributed to the report prepared for FISTERA (Foresight of the Information Society in the European Research Era) by the International Centre for Decision Sciences and Forecasting, Cracow. The aim of the above report was to catch new trends, processes, and phenomena concerning the IS current status and trends in all NMS. The research has been continued within the recent research project SCETIST yielding new general complex system modelling rules. To know the details of these findings, the reader is referred to further reports available at the project's web page www.ict.foresight.pl.

When carrying out the above mentioned research, it turned out that it is necessary to elaborate new methodological approaches to model the complex systems, as the classical foresight methods seemed insufficient or inadequate to cope with the IS complexity. The main objective of this paper is to present how the general rules and principles that govern the evolution of the IS and Information Technology (IT) have been retrieved, formulated in a mathematically strict manner, and analysed using cooperative methods and supporting on-line tools. We will provide a set of new methods to elicit the knowledge from experts and to analyse the technological evolution and the role of global IST development trends. We will also show how these methods can interact with other modelling approaches in a Living Lab digital environment.

The scope of general applicability of the methods and tools here presented extends beyond the original IS/IT observation playground, and most of them has been already used to analyse the environmental problems, such as inorganic waste foresight , or renewable energy prospects and roadmaps.

2 The Modelling Approach

The main research problem formulated within the research project that has been solved with the modelling approach presented in this paper can be formulated as follows: how the development of the IS in a country, or a group of countries, depends on the global processes of IT development and on integration of IS around the world, driven by the global trends. Among the latter one can consider a.o. falling telecommunication prices, the rise of information exchange through the internet, rapid diffusion of information innovations and technologies, and access to web information sources worldwide. The social phenomena, such as IT consumption patterns, preference dynamics, and civil society evolution, driven by the growing availability of e-government services and related web content have been taken into consideration as well.

The variety of aspects of the *Information Society* makes it difficult to provide a description that is clear, unambiguous and concise . One of the findings presented in was that the composite indicators based on statistical data are often non-reliable to explain future social behaviour. Therefore we decided to avoid using aggregates as a base of forecasts and recommendations. Instead, we have introduced a new class of input-output models based on a collaborative modelling principles , , , , , , , that fit well into the IS specificity. In particular, we have defined eight major elements of an IS that characterise its evolution in an adequate way, such as population and its demographics, legal system and IS policies, ITs infrastructures, etc. (cf. Fig.1).

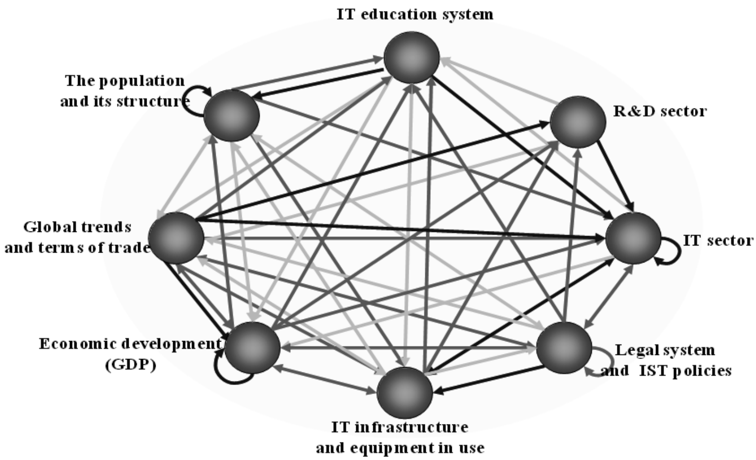

Fig.1. An example of a causal graph linking major groups of data used in the IS/IT evolution model: dark blue arrows denote strong direct dependence (both positive or negative), medium blue indicates average relevance of causal dependence, and light blue denotes weak dependence between subsystems. The feedback directions are not marked as they may vary for different subsystem variables.

During the analysis each of them appears as a bundle of discrete events, continuous trends and continuous or discretised state variables. The evolution of the IS is then modelled as a discrete-continuous-discrete-event system , where the mutual impacts of each of the elements are represented either in symbolic form, as generalised influence diagrams, or within the state-space models. External controls, such as legal regulations and policies, are modelled as discrete-event controls. Technological trends form inputs, while the feedback loops allow to model the influence of technological demand on the IT R&D, production, and supply.

Despite of the their rigid formulation, a characteristic feature of this class of models is the ability to use cooperative group model building techniques , and data fusion with the information gathered by autonomous agents in the web , . A new method for the complex system group assessment has been developed as well, namely the dynamic generalisation of the SWOT analysis (SWOT with “Challenges” an additional element). Used as TOWSC (TOWS with “Challenges” as above), it allows to give more adequate characteristics of an IS and its development perspectives. The combination of the dynamic evolution model and SWOTC yields a dynamic benchmarking scheme, that allows to compare different technologies, IS in different countries, or different sectors of the IT industry, catching their dynamics, and provide aggregate group characterisations.

3 Selected cooperative methods used in foresight

In this section we will give a brief overview of three cooperative methods that have been used when carrying out the foresight research .

3.1 Real-time Delphi

Delphi method that is the most frequently used for foresight research studies (cf. e.g. Linstone and Turoff). The method consists in questionnaire survey among an expert group where the survey is carried out several times whilst the experts are not able to contact each other on the subject matters. Each expert is asked to justify the presented results in terms of related rules, trends, and events. After collection of the results and completion of the analysis of them the project manager develops the next questionnaire version that narrows and more precisely details the surveyed area then the questionnaire is made available to the same experts or to a subset of this group. Usually the process must be repeated several times until a consensus or a ‚justified dissensus' between the experts is reached. The latter may lead to define several scenarios for the future. The Delphi may elicit expert opinions concerning the probability of specific events or time that they may happen in future. The results obtained may be used to construct the future scenarios, rank key technologies, provide recommendations to the decision-makers. They are frequently used as the initial material for panel workshops, where are discussed by experts and stakeholders.

During decades the above procedure has been performed by filling in paper questionnaires sent out to the experts by post. Due to the development of the web communication capabilities the Delphi can be performed as a real-time on-line process. The experts can enter the exercise at any time, after filling-in the on-line forms they can see immediately the results of the analysis. Passing to the next round is possible immediately after a specified minimum number of responses to the previous round is gathered. Thus Delphi can be regarded as a persistent anytime process. In addition, computer-assisted Delphi allows us to manage the trust and credibility of experts , , which is an essential problem when addressing a large group of experts with different educational background and diversified experience.

The above methodology has been implemented for the project as an online application. A collection of Delphi questionnaires devoted to the study of future development of basic IT, the fundamental problems of IS, decision support and expert systems, computer vision, neurocognitive systems as well as quantum and molecular computing is available on the web page www.ict.foresight.pl. Every member of the scientific community interested in the above subjects can contribute to the study.

3.2 Expert panels and brainstorming

Panel discussions are often regarded as the final stage of Delphi analysis. In the project they have been organised in the context of Delphi as well as carried out independently and combined with brainstorming. The latter is considered as a supplementary cooperative tool in foresight as well as a popular approach used in Living Labs. It consists in stimulation of maximum possible number of ideas intended to solve the problems posed by the brainstorming moderator. The phase when ideas are generated is separated from the phase of their evaluation. Such an approach encourages coming up with unconventional and innovative ideas and solutions. Participants of the brainstorm panels are allowed to combine and improve ideas presented by other panelists. The ideas are proprietary to the entire group and selection of the best solution may be carried out with use of the multi-criteria assessment, filtering out the dominated solutions first .

3.3 Collaborative SWOTC analysis

SWOTC analysis is a practically oriented extension (cf.) of the commonly known SWOT method. It was invented and applied for the first time to analyse the features of NMS Information Societies in 2004-2005 and to provide a diagnosis of current circumstances. Five groups of factors are analysed, namely Strengths, Weaknesses, Opportunities, Threats and Challenges. The introduction of Challenges that represent exogenous factors that may convert in both threats and opportunities depending on decisions that are made in the future or random events that are uncontrollable by the decision-makers. Thus SWOTC introduces dynamic factors into SWOT in a natural way, as the conversion of Challenges can be forecasted or planned. Therefore it is particularly useful for the corporate foresight and roadmapping , where SWOTC analysis is used as a basis to draw up the strategy for the company or a sector. The simplest form of the SWOTC method assumes development of a five-box table where strengths, weaknesses, opportunities, threats and challenges are itemized. Another option of the method is called TCOWS where the strengths and weaknesses present one axis of the coordinate system whilst threats, challenges and opportunities adhere to the second axis. That approach makes it possible to find out types of relationships between strengths (S) and weaknesses (W) as present features and future factors (O,T,C) on the other hand. The SWOTC method enables to easily switchover from the phase of analysis to the phase when strategic plans are developed. Thus it becomes a major creativity-stimulation method , which can be used simultaneously with other creative knowledge elicitation approaches and with brainstorming. The SWOTC analysis in foresight projects , has been supported by a collaborative on-line tool developed at the CDSF and available at www.foresight.pl.

4 Foresight research in a Living Lab digital ecosystem

An additional specificity of the above presented foresight exercise is the fact that the research has been carried out in a Living Lab digital ecosystem. The main ideas of Living Labs, i.e. user-centred research and open innovation, fit very well to foresight and have been actually implemented in the project presented in this paper a multidisciplinary team consisting, of experts employed by the consortium partners: economists and sociologists from the Jagiellonian University, Cracow, and quantum and molecular computing from a Polish Academy of Sciences institute in Gliwice, as well as the lead partner employees.

The consortium leader of SCETIST, the International Centre for Decision Sciences and Forecasting (ICDSF) of the Progress & Business Foundation, Cracow, has been admitted to the European Network of Living Labs (ENoLL), a European Living Labs umbrella organisation, as a result of the ENoLL 4th wave competition in March 2010, being its first member from Poland. The ICDSF's host organisation is the Progress and Business Foundation, one of the most respected technological foresight and innovation policy testbeds in Central Europe. While the pro-innovation and research activities of the P&BF date back to 1991, the ICDSF was founded as an autonomous Living Lab in May 2002.

The main areas of Living Lab activities of the ICDSF is to support innovative enterprises in planning their technological strategies, focused on ICT. A collaborative on-line (http://www.pbf.pl/innowacje/index.php) environment has been developed for the "Innovativeness Creator" program of the Polish Ministry of Science. It allows the Living Lab community to register innovations, check their financial viability with an advanced investment efficiency calculator, identify and value real options, and perform SWOTC. The experts can use the evaluation panel to assess the originality of the ideas submitted and provide their opinions and recommendations. The results are discussed at workshops attended by the innovation authors, evaluators, patent attorneys, representatives of financial institutions, and potential users.

Another strand of activities is directed towards assisting policy makers at the EU, country, or the regional level in developing the policies appropriately adjusted to new emerging socio-economic challenges. The ICDSF uses the Living Lab environment to promote the modern methods of computer-aided decision support, multicriteria decision analysis and optimisation methodology to its partners. The projects are performed by the ICDSF within the organisational structure of the Progress and Business Foundation and its subsidiary, the high-tech incubator. According to the Living Labs main ideas, the ICDSF's mission is to promote and use the interactive, user-centred, systematic, and objective approach in solving real-life problems to a maximum extent possible. For instance, a bundle of methods have been developed to assuring consistency, validation and verification of experts' judgements in Delphi and other cooperative use in foresight studies, including the project described in this paper.

The ICDSF networking capabilities has been enhanced by its participation in the European Science and Technology Observatory (ESTO) maintained by the DG JRC until 2005, then by the membership in the FISTERA, Crescendo, ETEPS and other European networks. The Living Lab has an access to the expertise of over 400 experienced experts representing relevant areas of science, technology, management, finance, and humanities.

5 Results and Conclusions

The new cooperative approaches sketched above allowed to build future development trends and scenarios more adequately, and to visualise their dynamics. The scenarios can again be used to re-examine IS and IT evolution principles, that all constitutes a consistent interactive and adaptive control model. It allows us to characterise the IS, rank and position the countries or regions under review in terms of the IS development. As the EU cohesion policy puts an emphasis on bridging up the digital divide, which, in turn, can be measured during a benchmarking process, more objective and quantifiable future IS characteristics allow us to define and recommend to the decision-makers more appropriate policy goals and measures to be implemented. The technological characteristics of the IS evolution give also clues to the IT providers as regards the future demand on IT, as well as to the R&D and educational institutions on the mostly wanted directions of development, in such fields as LMS, CMS, recommenders and decision support systems , and the demand for IT professionals. Comparing quantitative vs. descriptive approaches to build scenarios, one can notice that the approach of extracting evolution rules prior to the scenario analysis proves especially useful in case of the converging information societies, as exemplified by the IS in the EU NMS. The progress of the cohesion process seven years after the FISTERA foresight results were published, confirms that the modelling methods developed and applied have been adequate, and yielded a good coherence of forecasts and the ex-post real-life catch-up process.

6 Acknowledgement

The research presented in this paper has been supported by the project "Scenarios and Development Trends of Selected Information Society Technologies until 2025" financed by the ERDF within the Innovative Economy Operational Programme 2006-2013, Contract No. WND-POIG.01.01.01-00-021/09, www.ict.foresight.pl.

References:

Ackermann, F., Andersen, D.F., Eden, C., Richardson G.P. ScriptsMap: A tool for designing multi-method policy-making workshops. Omega 39, 427-434 (2011)

Antoniou, I., Reeve, M., Stenning, V. The Information Society as a Complex System. Journal of Universal Computer Science, Vol. 6, No. 3, 272-288 (2000)

Bérard, C. Group Model Building Using System Dynamics: An Analysis of Methodologi¬cal Frameworks. The Electronic Journal of Business Research Methods 8(1), 35-45 (2010), http://www.ejbrm.com/volume8/issue1 (retrieved Sept. 2012).

Cichy, B., A.M.J. Skulimowski, Inorganic waste of Polish chemical industry, Przem. Chem. 89(2010), No. 10, 1319–1323

Desthieux, G., Joerin, F., Lebreton, M. Ulysse: a qualitative tool for eliciting mental models of complex systems. Methodological approach and application to regional development in Atlantic Canada. Syst. Dyn. Rev. 26(2), 163-192 (2010)

Linstone, H.A., Turoff, M. (eds.): The Delphi Method. Techniques and Applications. Electronic version © Harold A. Linstone, Murray Turoff, p. 616 (2002)

Moyano, F., Fernandez-Gago, C., Lopez, J.: A Conceptual Framework for Trust Models, Trust, Privacy and Security in Digital Business, Lecture Notes in Computer Science, 7449, pp. 93-104. Springer-Verlag, Berlin-Heidelberg (2012)

Pallot M. (2009). Engaging Users into Research and Innovation: The Living Lab Approach as a User Centred Open Innovation Ecosystem. Webergence Blog. http://www.cwe-projects.eu [retrieved 2012-09]

Skulimowski, A.M.J.: Optimal strategies for quantitative data retrieval in distributed database systems. Proceedings of the Second International Conference on Intelligent Systems Engineering, Hamburg, 5-9 September 1994; IEE Conference Publication Nr 395, IEE, London; pp. 389-394 (1994)

Skulimowski A.M.J. "Framing New Member States and Candidate Countries Information Society Insights".- In : Ramon Compano and Corina Pascu (Ed.) „Prospects For a Knowledge-Based Society in the New Members States and Candidate Countries, Publishing House of the Romanian Academy, 2006, pp. 9-51 (2006)

Skulimowski, A.M.J.: Freedom of Choice and Creativity in Multicriteria Decision Making. In: T. Theeramunkong, S. Kunifuji, C. Nattee, V. Sornlertlamva nich (Eds.) Knowledge, Information, and Creativity Support Systems: KICSS2010 Revised Selected Papers, LNAI, Vol. 6746, Springer, Berlin; Heidelberg (2011), pp. 190-203

Skulimowski A.M.J. Future Trends of Intelligent Decision Support Systems and Models. Futuretech 2011, Part I, CCIS, Vol. 184, Springer, pp.11-20 (2011)

Skulimowski, A.M.J.: Discovering Complex System Dynamics with Intelligent Data Retrieval Tools. In: Zhang, Y. et al. (eds.): Sino-foreign-interchange workshop on Intelligent Science and Intelligent Data Engineering IScIDE 2011, Xi'an, China, Oct. 23-26, 2011, Lecture Notes in Computer Science, 7202, pp. 614-626. Springer, Berlin–Heidelberg (2012)

Skulimowski, A.M.J.: Anticipatory Network Models of Multicriteria Decision-Making Processes. Int. J. Systems Sci., iFirst (2012) DOI:10.1080/00207721.2012.670308

Skulimowski, A. M. J., Pukocz, P. On-line technological roadmapping as a tool to implement foresight results in IT enterprises. In: Internet – technical developments and applications 2, A. Kapczyński, E. Tkacz, M. Rostanski, Eds., Advances in Intelligent and Soft Computing, vol. 118, Springer-Verlag, 95–111 (2012)

Skulimowski, A.M.J., Schmid, B.F. Redundancy-free description of partitioned comp¬lex systems. Mathematical and Computer Modelling, 16, No.10, 71-92 (1992)

Skulimowski, A.M.J. et. al. "Scenarios and Development Trends of Selected Information Society Technologies until 2025 (SCETIST)", 2011 Interim Report, Progress & Business Foundation, Kraków, www.ict.foresight.pl (2012)

Skulimowski, A.M.J., Stasiak, K.: Managing trust and credibility in on-line expert Delphi. In: Scenarios and Development Trends of Selected Information Society Technologies until 2025", Progress & Business Publishers, Kraków (2012, in press)

Tapscott, D., Williams, A. D.: Wikinomics: How Mass Collaboration Changes Everything, 3rd Ed., Portfolio Trade (2010)

Tovey, M. (Ed.): Collective Intelligence: Creating a Prosperous World at Peace. Earth Intelligence Network, Oakton, VA (2008)

Vennix, J.A.M. Group model-building: tackling messy problems. Syst. Dyn. Rev. 15, 379-401 (1999)