

## **Foresight and Technology Monitoring in the Information and Communication Technologies (ICTs)**

### **1. General Description of the Course**

“The Foresight and Technology Monitoring in Information and Communication Technologies (ICTs)” course is delivered to bachelor and master students of The National Research University - Higher School of Economics/HSE at the Business Informatics Programme. The course will be organized as a series of seminars and lectures. Seminars will be mainly informative and will aim at giving background information and raising awareness on the topic. Lectures will be more participative and interactive and will aim at building capacity on how to implement the theory of Foresight in practice in the field of ICTs with case studies.

The course will be a combination of lectures and seminars with a self-study in the form of essay writing and final oral presentations. In total, 16 academic hours of lectures will be delivered consecutively from September to December 2012 (each lecture will be delivered in 2 academic hours with 2 academic hours of self-study time for each lecture). Along with the lectures, seminars will be given for students to apply and practice what they learned in lectures through a hands-on practical exercise. Students will be given an essay task, which will help them to gain an in depth knowledge on the topic. A final seminar session will take place in December 2012, where students will give oral presentations on their selected topic for the practical exercise to demonstrate the level of knowledge they gained throughout the semester.

The overall performance of students will be measured through essay writing on their selected topic, a presentation upon the completion of the lectures and seminars, and the level of their active participation in discussions.

### **2. Course outline**

Information and Communication Technologies (ICTs) have become one of the basic building blocks of modern society within a very short time. ICTs are critical in terms of improving the competitiveness of economies and industry and meeting the demands of society. The critical impacts of ICTs can be observed in a number of areas including (i) Innovation and increased productivity by facilitating creativity and management; (ii) Modernisation of services such as health, finance, education and transport; (iii) Advances in Science and Technology by enabling access to information, generation new information and knowledge and processing complex data sets; and (iv) Real time communication and networking within and between societies and businesses. As a result, the development of ICTs have been crucial both for developed and developing economies in the world. The area witnesses intensive competition with a high number of hardware and software applications becoming available at a very high rate.

Recognizing all these developments, the proposed course, entitled “Foresight in ICTs” aim to increase the awareness of the rapid developments in the field, to discuss what alternative futures might be observed in the coming years, and to present various quantitative and qualitative techniques to predict and shape the future of the field. The course will cover the following lecture and seminar topics.

#### *Lecture topics*

1. Introduction to Foresight: Concepts and Approaches
2. Foresight methodology and frequently used methods
3. Applications of Foresight in the field of the ICTs
4. Quantitative and qualitative methods for Technology Monitoring
5. Monitoring Technologies in the ICTs
6. Formulating strategies and actions for the ICTs
7. Integrating the results of Foresight and Technology Monitoring into business R&D planning
8. Roadmapping for Technologies and Markets in the ICTs

#### *Seminar topic*

1. Practical application of Foresight and Technology Monitoring in the ICTs

The first lecture (Topic 1), “Introduction to Foresight: Concepts and Approaches” will begin with the introduction of the Foresight concept as a systematic and participative way of anticipating the future through intelligence gathering with the aim of developing long term visions and mobilizing joint actions. Basic methodologies, approaches and types of Foresight studies conducted at the national, regional, corporate and sectoral levels will be presented. Furthermore the principles of planning and monitoring a Foresight study project will be highlighted. Since Foresight studies often form the basis for strategy development of companies and governments, the long term success of the strategies developed depend on the quality of the Foresight studies. The quality of Foresight studies strongly depends on the information and knowledge sources used in course of the Foresight studies. Thus the topic will put much emphasis on the information sources and management of information / knowledge sources and on quality management concepts suitable for Foresight studies.

Topic 2, “Foresight methodology and frequently used methods”, introduces quantitative and qualitative methods used in Foresight studies. Following the presentation of a wide variety of methods and ways of mapping them, the lecture will focus on some of the main methods commonly used in Foresight including Horizon Scanning, Modeling, Scenario Planning, Delphi surveys, Roadmapping and Critical/Key Technologies. A set of conceptual frameworks will be presented for ordering and combining Foresight methods.

Topic 3, “Applications of Foresight in the field of the ICTs”, will present case examples from a number of Foresight exercises, which have been undertaken to look into the future of the ICTs

to identify future trends, emerging opportunities and threats. A stocktaking of these exercises at the national, regional, corporate and thematic levels will be done during this module.

Topic 4, “Quantitative and qualitative methods for Technology Monitoring”, gives an in-depth information on selected quantitative and qualitative methods frequently used for the purpose of Technology Monitoring. These include Bibliometric analysis, Data mining, web scraping, wild card and weak signal analysis, and trend impact analysis.

Topic 5, “Monitoring Technologies in ICTs”, will focus on the ways of monitoring technology trends in the field of the ICTs. Trend monitoring will aim to provide an early indications of potential emerging new and disruptive technologies and thus giving the lead time for stakeholders to plan and address potential disruptions in the field and suggesting tools for prioritizing potential opportunities and threats and allocating resources to increase the ability to capitalise on, protect against, or mitigate the impacts of potential disruptions in the field.

Topic 6, “Formulating strategies and actions for the ICTs”, will present various ways for the identification of priorities in the ICTs sector, decisions on organizational and capacity requirements to respond to those priority areas, and formulation of policies and actions for the realization of future visions. This topic will cover case examples on how results of Foresight and Technology Monitoring have been used by governments and corporations in policy formulation and business planning processes.

Topic 7, “Integrating the results of Foresight and Technology Monitoring into S&T formulation and business R&D strategy planning”, discusses the implications of Foresight and Technology Monitoring on present-day decision-making. Analytical frameworks will be presented for integrating the results of Foresight and Trend Monitoring in national Science and Technology strategy and Corporate R&D planning.

Topic 8, “Roadmapping for Technologies and Markets in the ICTs” focuses on the development of integrated roadmaps which indicate pathways towards desired technological advancements and market opportunities. As a frequently used method within industry and corporations, Roadmapping is a tool for innovation and technology management, strategic and operational decision making and action planning.

The lectures will be complemented by a seminar on the “Practical Applications of Foresight and Technology Monitoring in the ICTs”. During the seminar the students will exercise a practical Foresight study on a predefined ICT related technology, a specified ICT related social dimension or an application. The students will learn how to use the Foresight methodologies taught in the lecture in a real life example. Eventually students are expected to prepare a business plan for an ICT application, a research project plan or a general roadmap.

During the course, the seminars and lectures will follow the same module structure. Each module will involve discussions on the implications of the areas focused for the Information and Communication Technologies sector in the Russian Federation.

### 3. Pre-requisites

- Basics of economics and / or management
- Basics of creative, critical and interactive thinking
- Basics of policy and institutional analysis
- Basic understanding of the relationships between STI and socio-economic development
- Interdisciplinary and systemic thinking

### 4. Target audience

- Bachelor and master students of The National Research University - Higher School of Economics/HSE at the Business Informatics Program.

### 5. Thematic Plan

#### a) Lectures

<i>Topics</i>	<i>Total academic hours</i>	<i>lectures (class hours)</i>	<i>Self study</i>
1. Introduction to Foresight: Concepts and Approaches	4	2	2
2. Foresight methodology and frequently used methods	4	2	2
3. Applications of Foresight in the field of the ICTs	4	2	2
4. Quantitative and qualitative methods for Technology Monitoring	4	2	2
5. Monitoring Technologies in the ICTs	4	2	2
6. Formulating strategies and actions for the ICTs	4	2	2
7. Integrating the results of Foresight and Technology Monitoring into business R&D planning	4	2	2
8. Roadmapping for Technologies and Markets in the ICTs	4	2	2
<b>total</b>	<b>32</b>	<b>16</b>	<b>16</b>

## b) Seminars

<b>Topics</b>	<b>Total academic hours</b>	<b>seminars</b>	<b>Self study</b>
Introduction presentation on the "Practical applications of Foresight and Trend Monitoring in the ICTs"		2	
Student work			6
Consultations	2		2
Presentations and discussions		6	
<b>total</b>	<b>16</b>	<b>8</b>	<b>8</b>

## 6. Time Plan

## a) Lectures

<b>Topic</b>	<b>date</b>
Introduction to Foresight: Concepts and Approaches	11 Sep 2012
Foresight methodology and frequently used methods	18 Sep 2012
Applications of Foresight in the field of the ICTs	25 Sep 2012
Quantitative and qualitative methods for Technology Monitoring	16 October
Monitoring Technologies in the ICTs	23 October
Formulating strategies and actions for the ICTs	30 October
Integrating the results of Foresight and Technology Monitoring into business R&D planning	4 December
Roadmapping for Technologies and Markets in the ICTs	11 December

## b) Seminars

<b>Topic</b>	<b>date</b>
Introduction presentation	02 Nov 2012
Presentations and discussions	21 December

## 7. Basic literature

- Ackoff, R.L. (1974). "Redesigning the Future: A Systems Approach to Societal Problems", John Wiley and Sons, New York.
- Checkland, P. (1981). "Systems Thinking, Systems Practice", Wiley, Chichester.
- Churchman, C.W. (1968). "The Systems Approach", Dell Publishing, New York.
- Coates, J.F. (1985). Foresight in federal government policy making, "Futures Research Quarterly", 1, 29-53.
- Georghiou, L., Harper, J.C., Keenan, M., Miles, I., Popper, R. (2008). "The Handbook Of Technology Foresight", Edward Elgar, Cheltenham.
- Klochikhin, E.A. and Saritas, O. (2011). "Development of an approach for the integration of the results of the global technology trend monitoring into the S&T policy formulation process", A report produced for the Higher School of Economics (HSE), the Institute for Statistical Studies and Economics of Knowledge (ISSEK).
- Klochikhin, E.A. and Saritas, O. (2011). "An overview of the technology trend monitoring experience of leading research centres on the identification of global technology trends", A report produced for the Higher School of Economics (HSE), the Institute for Statistical Studies and Economics of Knowledge (ISSEK).
- Miles, I and Keenan, M. (2002). "Practical Guide to Regional Foresight in the UK", Publications of the European Communities, Luxembourg.
- Porter, A.L., and Cunningham, S.W. (2005). "Tech Mining: Exploiting New Technologies for Competitive Advantage", New York: Wiley.
- Robinson, D.K.R., Huang, L., Guo, Y., and Porter, A.L., Forecasting Innovation Pathways for New and Emerging Science & Technologies, Technological Forecasting & Social Change, Article in Press (Available at: <http://www.sciencedirect.com/science/article/pii/S0040162511001284> - last visited on: January 15, 2012).
- Saritas, O. and Klochikhin, E.A. (2011). "A methodological approach for the identification of global technology trends", A report produced for the Higher School of Economics (HSE), the Institute for Statistical Studies and Economics of Knowledge (ISSEK).
- Saritas, O. and Klochikhin, E.A. (2011). "Identification and description of global technology trends for semantic technologies", A report produced for the Higher School of Economics (HSE), the Institute for Statistical Studies and Economics of Knowledge (ISSEK).
- Saritas, O. and Smith, J. (2011). "Considerations in the use of quantitative and qualitative methods for extracting and compiling knowledge for Foresight", A report produced for the Higher School of Economics (HSE), the Institute for Statistical Studies and Economics of Knowledge (ISSEK).
- Saritas, O. and Smith, J. (2011). "Integration of quantitative and qualitative methods within the concept of the Systemic Foresight Methodology", A report produced for the Higher School of Economics (HSE), the Institute for Statistical Studies and Economics of Knowledge (ISSEK).

- Smith, J. and Saritas, O. (2011). “Approaches for ordering quantitative and qualitative methods for extracting and compiling knowledge”, A report produced for the Higher School of Economics (HSE), the Institute for Statistical Studies and Economics of Knowledge (ISSEK).
- Smith, J. and Saritas, O. (2011). “Best practices for combining quantitative and qualitative Foresight methods”, A report produced for the Higher School of Economics (HSE), the Institute for Statistical Studies and Economics of Knowledge (ISSEK).

## 8. Education control forms

Final presentations (F): oral presentations (10 minutes presentation + 5 minutes questions and answers)

Essay (E): Individual mini-report on the potential uses of Foresight in student’s own area of interest in the ICTs (1500 words of text)

Participation (P): Attendance to lectures and seminars, and active participation to discussions

The overall course grade (10-point scale) is calculated as a sum of

$$G = 0,4 F + 0,5 E + 0,1 P$$

The overall course grade  $G$  (10-point scale) includes results achieved by students in their final presentation ( $F$ ), essay ( $E$ ), and participation ( $P$ ). The overall grade is rounded up to an integer number of points.

### Summary Table: Correspondence of ten-point to five-point system’s marks

Ten-point scale [10]	Five-point scale [5]
1 – unsatisfactory 2 – very bad 3 – bad	Unsatisfactory – 2
4 – satisfactory 5 – quite satisfactory	Satisfactory – 3
6 – good 7 – very good	Good – 4
8 – nearly excellent 9 – excellent 10 – brilliant	Excellent – 5

## 9. Programme Contents

### Topic 1 Introduction to Foresight: Concepts and Approaches

Topic outline:

- National, regional, corporate and sectoral Foresight
- Foresight study project planning
- Monitoring and management of foresight studies
- Information sources and management of information / knowledge sources
- Quality management

#### Main references/books/reading:

- Ackoff, R.L. (1981). "Creating the Corporate Future", John Wiley and Sons, New York.
- Churchman, C.W. (1968). "The Systems Approach", Dell Publishing, New York.
- Daheim, C. and Uerz, G. (2006). "Corporate Foresight in Europe: Ready for the next step?" (Available at: [http://www.z-punkt.de/fileadmin/be\\_user/D\\_Publikationen/D\\_Arbeitspapiere/Corporate\\_Foresight\\_in\\_Europe.pdf](http://www.z-punkt.de/fileadmin/be_user/D_Publikationen/D_Arbeitspapiere/Corporate_Foresight_in_Europe.pdf) - last visited on January 15, 2012).
- European Foresight Monitoring Network (2009). "Mapping Foresight: Revealing how Europe and other world regions navigate into the future" (Available at: <ftp://ftp.cordis.europa.eu/pub/fp7/ssh/docs/efmn-mapping-foresight.pdf> - last visited on January 13, 2011).
- Georghiou, L. and Keenan, M. (2006). Evaluating National Technology Foresight Exercises, Technological Forecasting and Social Change, vol. 73, pp 761-777.
- Loveridge, D. (2009). "Foresight: The art and science of anticipating the future", Routledge, New York and London.
- Martin, B.R. (1995). Foresight in Science and Technology, "Technology Analysis and Strategic Management", vol. 7, 2, 139-168.
- Miles, I. and Keenan, M. (2002). "Practical Guide to Regional Foresight in the UK", Publications of the European Communities, Luxembourg.
- Reger, G. (2001). Technology Foresight in companies: from an indicator to a network and process perspective, "Technology Analysis and Strategic Management", vol.13, issue 4, pp. 533-553.
- Salo, A. (2001). Incentives in technology foresight, "International Journal of Technology Management", Vol. 21, No. 7-8, pp. 694-710.
- UNIDO Technology Foresight Manual (available on: <http://www.unido.org/index.php?id=o5216> last visited on January 15, 2012).

## **Topic 2 Foresight methodology and frequently used methods**

#### Topic outline:

- The role and use of methods in Foresight for extracting and compiling knowledge
- Qualitative and Quantitative methods in Foresight
- Approaches in ordering and combining Foresight methods
- Case examples

#### Main references/books/reading:

- Godet, M. (2000). The art of scenarios and strategic planning: tools and pitfalls, "Technological Forecasting and Social Change", vol. 65, pp. 3-22.

- Klusacek, K. (2006). "Selection of research priorities – method of critical technologies", Technology Centre of the Academy of Sciences, Prague (Available at: [http://www.strast.cz/dokums\\_raw/unidoccoursecriticaltechnologies10291\\_937.pdf](http://www.strast.cz/dokums_raw/unidoccoursecriticaltechnologies10291_937.pdf) - last visited on: January 15, 2012).
- Linstone, H. and Turoff, M. (1975) "The Delphi Method: Techniques and Applications" (Available at: <http://is.njit.edu/pubs/delphibook/> - last visited on: January 15, 2012).
- Loveridge, D. and Saritas, O. (2011). "Combining quantitative and qualitative in FTA: Rediscovery or something new?", 4th Foresight and Technology Analysis (FTA) Conference, Seville (Available at: [http://foresight.jrc.ec.europa.eu/fta\\_2011/documents/download/PAPERS/THEME%203/3f%20Combining%20quantitative%20and%20qualitative%20tools/Loveridge-Saritas.doc](http://foresight.jrc.ec.europa.eu/fta_2011/documents/download/PAPERS/THEME%203/3f%20Combining%20quantitative%20and%20qualitative%20tools/Loveridge-Saritas.doc) - last visited on January 13, 2012).
- Mietzner, D and G. Reger (2005) "Advantages and disadvantages of scenario approaches for strategic foresight", International Journal for Technology Intelligence and Planning, Vol. 1, No. 2, pp. 220-230.
- Nugroho, Y. and Saritas, O. (2011). Seeing the invisible and making sense of it: Scans, Networks and Scenarios (in Russian), "ФОРСАЙТ" (Russian language Foresight journal), vol. 5, no. 3, pp. 58-69.
- Phaal, R., Farrukh, C., and Probert, D. (2001). "Technology Roadmapping: Linking technology resources to business objectives", Centre for Technology Management, University of Cambridge (Available at: [http://www.ifm.eng.cam.ac.uk/ctm/publications/tplan/trm\\_white\\_paper.pdf](http://www.ifm.eng.cam.ac.uk/ctm/publications/tplan/trm_white_paper.pdf) - last visited on: January 15, 2012).
- Saritas, O. (2011). "Integration of Quantitative and Qualitative methods within the concept of the Systemic Foresight Methodology", A research note produced for Higher School of Economics, ISSEK.
- Saritas, O. and Nugroho, Y. (2011). Mapping issues and envisaging futures: An evolutionary scenario approach, "Technological Forecasting and Social Change", Accepted for publication (Available at: <http://www.sciencedirect.com/science/article/pii/S0040162511002046> - last visited on: January 15, 2012).
- Saritas, O. and Smith, J. (2011). The Big Picture – trends, drivers, wild cards and weak signals, "Futures", 43, 292-312.
- Smith, J. and Saritas, O. (2011). A Pocket Primer of Comparative and Combined Foresight Methods, "Foresight", YIRCoF '09 Conference special issue, guest edited by Asist. Prof. Senem Gol Beser, vol. 13, issue 2, pp. 79-96.
- UK Horizon Scanning Centre (Available at: <http://www.bis.gov.uk/foresight/our-work/horizon-scanning-centre> - last visited on January 15, 2012).
- van der Heijden, K. (1998). "Scenarios: the Art of Strategic Conversation", John Wiley.

### **Topic 3 Applications of Foresight in the field of the ICTs**

#### Topic outline:

- Introduction to the Foresight concept
- Stocktaking of Foresight exercises in the field of the ICTs

Main references/books/reading:

- Cremonini, A.L. and Rathmell, C.W. (2003). "Cyber Trust and Crime Prevention: Foresight overview", A report prepared by RAND Europe for the Foresight Directorate, Office of Science and Technology, UK (Available at: [http://www.bis.gov.uk/assets/bispartners/foresight/docs/cyber/cyber\\_trust\\_foresight\\_overview.pdf](http://www.bis.gov.uk/assets/bispartners/foresight/docs/cyber/cyber_trust_foresight_overview.pdf) - last visited on January 15, 2012).
- Donohue, M. and Ypsilanti, D. (2009). "Cloud Computing and Public Policy", Briefing Paper for the ICCP Technology Foresight Forum, OECD Directorate for Science, Technology and Industry (Available at: <http://www.oecd.org/dataoecd/39/47/43933771.pdf> - last visited on: January 15, 2012).
- European Foresight Monitoring Network (2009). "Mapping Foresight: Revealing how Europe and other world regions navigate into the future" (Available at: <ftp://ftp.cordis.europa.eu/pub/fp7/ssh/docs/efmn-mapping-foresight.pdf> - last visited on January 13, 2011).
- Ferreira, A. (2009). "Road-mapping the Digital Revolution: Visions from COST Foresight 2030", IEEE (Available at: [www.cost.esf.org/module/download/7542](http://www.cost.esf.org/module/download/7542) – last visited on: January 15, 2012).
- FISTERA (2006). "Foresight on Information Society Technologies in the European Research Area", Institute for Prospective Technology Studies (IPTs), DG-JRC, European Commission (Available at: <http://ftp.jrc.es/EURdoc/eur22319en.pdf> - last visited on: January 15, 2012).
- RAND (2006). "The Global Technology Revolution 2020", In-Depth Analyses: Bio/Nano/Materials/Information Trends, Drivers, Barriers, and Social Implications, National Security Research Division, RAND (Available at: [http://www.rand.org/pubs/technical\\_reports/2006/RAND\\_TR303.pdf](http://www.rand.org/pubs/technical_reports/2006/RAND_TR303.pdf) - last visited on January 15, 2012).

**Topic 4 Quantitative and qualitative methods for Technology Monitoring**Topic outline:

- Technology Trend Monitoring Methodology: Process and phases
- Quantitative and qualitative methods for Technology Monitoring including Bibliometric Analysis, Patent Analysis, Web Scraping, Horizon Scanning, Wild Card and Weak Signal Analysis
- The application of the quantitative and qualitative methods in the ICTs

Main references/books/reading:

- Dupin, F. and Adolph, M., 2011. "Digital signage: the right information in all the right places", ITU-T Technology Watch Report. Available at: <http://www.itu.int/en/ITU-T/techwatch/Pages/digital-signage-standards.aspx>.
- Kostoff, R.N. (1999). "Science and Technology Innovation". Technovation 19.
- Kostoff, R.N. (2003). "Science and technology text mining: Global Technology Watch", U.S. Navy, Office of Naval Research.
- Losiewicz, P., Oard, D.W., and Kostoff, R.N. (2003). "Science and technology text mining: Basic concepts", Office of Naval Research, U.S. Navy.

- Mrakotsky-Kolm, E., and Soderlind, G. (2009). "Final recommendations towards a methodology for technology watch at EU level", STACCATO Deliverable 2.2.1. Available at: [http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/12930/1/reqno\\_jrc50348\\_staccato%20tech%20watch.pdf](http://publications.jrc.ec.europa.eu/repository/bitstream/111111111/12930/1/reqno_jrc50348_staccato%20tech%20watch.pdf).
- NASA (2011). "Technology Readiness Levels definitions", Available at: [http://esto.nasa.gov/files/TRL\\_definitions.pdf](http://esto.nasa.gov/files/TRL_definitions.pdf).
- National Academy of Sciences (2005). "Avoiding Surprise in an Era of Global Technology Advances", National Academies Press, Washington, D.C.
- Official TechCast website – [www.techcast.org](http://www.techcast.org)

## **Topic 5 Monitoring Technologies in ICTs**

### Topic outline:

- Uses of Technology Monitoring in the field of the ICTs
- ICTs Trend Monitoring Cases

### Main references/books/reading:

- Bragge, J. and Storgards, J. (2007). "Utilizing text-mining tools to enrich traditional literature reviews: Digital Games", Proceedings of the 30th Information Systems Research Seminar in Scandinavia IRIS, Tampere, Finland, August 11-14 (Available at: <http://www.cs.uta.fi/reports/dsarja/D-2007-9.pdf> - last visited on January 13, 2011).
- Cuel, R., Delteil, A., Louis, V. and Rizzi, C. (2008). "Knowledge Web Technology Roadmap: The Technology Roadmap of the Semantic Web" (Available at: <http://knowledgeweb.semanticweb.org/o2i/menu/KWTR-whitepaper-43-final.pdf> - last visited on January 13, 2012).
- International Telecommunications Union Technology Watch (Available at: <http://www.itu.int/en/ITU-T/techwatch/Pages/default.aspx> - last visited on January 13, 2012).
- Kostoff, R.N. (2003). "Science and technology text mining: Global Technology Watch". U.S. Navy.
- Nambisan, S., Sawhney, M. (2008). "The global brain: Your roadmap for innovating faster and smarter in a networked world". Pearson Education, Inc., Upper Saddle River, NJ.
- Phaal, R. (2011). "Public domain roadmaps, Centre for Technology Management, University of Cambridge" (Available at: [http://www.ifm.eng.cam.ac.uk/ctm/trm/documents/public\\_domain\\_roadmaps.pdf](http://www.ifm.eng.cam.ac.uk/ctm/trm/documents/public_domain_roadmaps.pdf) - last visited on January 13, 2011).
- Saritas, O. and Klochikhin, E.A. (2011). "A methodological approach for the identification of global technology trends", A report produced for the Higher School of Economics (HSE), ISSEK.

## **Topic 6 Formulating strategies and actions for the ICTs**

### Topic outline:

- Translating Foresight into action: Communication, Participation, Experimentation, Integration
- Methods for connecting the future with the present

- Practical issues in the integration of Foresight and Technology Monitoring into S&T policy and strategy

Main references/books/reading:

- Carlsson, B., Jacobsson, S. (1997). Diversity creation and technological systems: a technology policy perspective, in: Edquist, C. (Ed.), "Systems of Innovation: Technologies, Institutions and Organisations", Pinter, London.
- Flanagan, K., Uyarra, E., Laranja, M. (2011). Reconceptualising the 'policy mix' for innovation, "Research Policy", 40, 5, 702-713.
- Kostoff, R.N., Boylan, R. and Simons, G.R. (2004). Disruptive technology roadmaps, "Technological Forecasting and Social Change", vol. 71, 141-159
- Lundvall, B.-A., Johnson, B., Andersen, E.S., Dalum, B. (2002). National systems of production, innovation and competence building, "Research Policy", 31 (2), 213-231.
- Markard, J. and Truffer, B. (2008). Technological innovation systems and the multi-level perspective: Towards an integrated framework, "Research Policy", 37(4), 596-615.
- Phaal, R., Farrukh, C.J.P. and Probert, D.R. (2004). Technology roadmapping – a planning framework for evolution and revolution, "Technological Forecasting and Social Change", vol. 71, 5-26
- Saritas, O. and Aylen, J. (2010). Using scenarios for roadmapping: The case of clean production, "Technological Forecasting and Social Change", vol. 77, issue 7, pp. 1061-1075.
- Smits, R.E., Kuhlmann, S., 2004. The rise of systemic instruments in innovation policy, "International Journal of Foresight and Innovation Policy" 1(1-2), 4-32.

**Topic 7 Integrating the results of Foresight and Technology Monitoring into business R&D planning**

Topic outline:

- National and technological innovation systems: complementarity of policy approaches
- Analytical framework for the integration of the results of policy global Technology Trend Monitoring (TTM) into the process of STI formulation
- Analytical framework for the integration of the results of the global Technology Trend Monitoring into the process of business R&D strategy planning
- Practical aspects of integrating Foresight and Technology Monitoring into policy and strategy

Main references/books/reading:

- Dawson, B. (2007). "The impact of technology insertion on organizations", Human Factors Integration Design Technology Centre.
- Dolata, U. (2009). Technological innovations and sectoral change. Transformative capacity, adaptability, patterns of change: An analytical framework, "Research Policy", 38(6), 1066-1076.
- Engel, J.S. (2011). Accelerating corporate innovation: Lessons from the venture capital model, "Research-Technology Management", 54(3), 36-43.
- Freeman, C. (1987). "Technology policy and economic performance: Lessons from Japan". Pinter, London.
- Freeman, C. (2002). Continental, national and sub-national innovation systems – complementarity and economic growth, "Research Policy", 31(2), 191-211.

- Lundvall, B.-A., Johnson, B., Andersen, E.S., Dalum, B. (2002). National systems of production, innovation and competence building, "Research Policy", 31 (2), 213-231.
- Smits, R.E., Kuhlmann, S., Shapira, P. (2010). "The theory and practice of innovation policy: An international research handbook", Edward Elgar, Northampton, Mass., and Cheltenham.

## **Topic 8 Roadmapping for Technologies and Markets in the ICTs**

### Topic outline:

- Roadmapping methodology – milestone setting, portfolio planning, milestone and portfolio monitoring
- Strategy building based on roadmapping – norm strategies
- Strategy implementation – resource allocation and organizational matters
- Competitive intelligence
- Roadmapping case examples

### Main references/books/reading:

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