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 will delivered to Bachelor students of the "Business Informatics Programme" and Master students of the "Electronic Business Programme" at the Faculty of Business Informatics, the Higher School of Economics. The course will be organized as a series of lectures and seminars, which are designed separately for the Bachelor and Master students in line with their levels and requirements of their programmes. For both groups, lectures will be mainly informatory and will aim at giving background information and raising awareness on the topic. Students will be given opportunities to apply and practice what they learned in lectures through case studies and hands-on practical exercises in a more participative and interactive way.

In total, 32 classroom hours of lectures will be delivered at the Bachelor programme, and 40 hours at the Masters programme respectively during the 3rd semester (module) of the year. Each lecture will be delivered in 4 academic classroom hours with 1 academic hour of self-study time for each lecture. Lectures will be combined with a self-study in the form of essay writing and final oral presentations. Students will be given an essay task, which will help them to gain an in depth knowledge on the topic. Both Bachelors and Masters lectures will be complemented by seminars on "Practical applications of Foresight and Trend Monitoring in the ICTs" 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 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 de-

veloping 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" will 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 be custumised for the requirements of the Bachelor and Masters programme and will cover the following topics:

Lecture topics for the Bachelor programme:

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. Technology and Market Dynamics in the ICTs Sector: The Case of Russia
7. Roadmapping for Technologies and Markets in the ICTs
8. Formulating strategies and actions for the ICTs

Lecture topics for the Masters programme:

1. Foresight: Evolution of the practice
2. Global Practices and Processes of Foresight
3. Overview of Key Foresight Methods: Horizon Scanning, Scenarios, Delphi and Roadmaps
4. Global Megatrends and Grand Challenges
5. The Role of ICTs to Address Grand Challenges and Socio-Economic Prosperity
6. ICTs in BRIC Countries: Foresight, Policies and Priorities
7. Monitoring Technology Trends: Definitions, Application Domains, Case Studies
8. Technology Trend Monitoring Methods and Software Applications
9. HSE Technology Trend Monitoring Approach: The Case of Semantic Technologies
10. Integrating the Results of Foresight and Technology Monitoring into Public STI Policy and Business R&D Planning

Description of the lecture topics for the Bachelors programme

Lecture 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.

Lecture 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.

Lecture 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.

Lecture 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.

Lecture 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 capitilise on, protect against, or mitigate the impacts of potential disruptions in the field.

Lecture 6, "Technology and Market Dynamics in the ICTs Sector: The Case of Russia" will review the ICTs, which is one of the fastest growing sectors in the world. Following the review of global technology and markets across the world, the lecture will focus on Russia, as a country, which has long been a pioneer in science and technology research, development, and investment in the IT industry. Recent developments in the ICTs sector from the industry, research and policy sides will be presented in the scope of this lecture.

Lecture 7, "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.

Lecture 8, "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.

Description of the lecture topics for the Masters programme

Lecture 1, "Foresight: Evolution of the practice" will review the evolution of Foresight, and how the term has been used to explain a wide variety of forward looking studies through the decades starting from the 1950's Technology Forecasting to today's Technology and Social Foresight.

Lecture 2, "Global Practices and Processes of Foresight" will focus on the wide variety of Foresight activities conducted across the world at the international, national, regional and corporate levels. A benchmarking of Foresight practices will be presented and key priorities of different world regions will be highlighted.

Lecture 3, "Overview of Key Foresight Methods: Horizon Scanning, Scenarios, Delphi and Roadmaps" will first present a typology of Foresight methods and then will describe the most frequently used Foresight methods including Horizon Scanning, Scenarios, Delphi and Roadmaps. Experience from the practice of using these methods will be shared.

Lecture 4, "Global Megatrends and Grand Challenges" will talk about the great forces in social, technological, economic, environmental, political developments that will affect all areas – state, market and civil society for many years to come. These will include Global Megatrends observed in demographical change, natural resource availability, technological change along with Grand Challenges related to such as Energy, Water and Sustainable Development.

Lecture 5, "The Role of ICTs to Address Grand Challenges and Socio-Economic Prosperity" will discuss the role of Information and Communication Technologies to overcome the Grand Challenges, while providing opportunities for increasing the quality of life of societies while contributing to economic prosperity. Some of the key advancements in the ICT technologies and emerging market demands will be covered in the lecture.

Lecture 6, "ICTs in BRIC Countries: Foresight, Policies and Priorities" aims to take a closer look at the ICTs landscape in Brazil, Russia India and China (BRICs) as these countries are proving to be the major engines of the global growth with considerable advancements in the ICTs sector. Recent developments in these countries will be reviewed and their Strengths, Weaknesses, Opportunities and Threats will be benchmarked.

Lecture 7, "Monitoring Technology Trends: Definitions, Application Domains, Case Studies" will look at the Technology Trend Monitoring efforts, which are becoming more and more important due to the increasing number of information sources and the need to make sense of them in a fairly short time to understand the future direction of technological developments. Definitions of the Technology Trend Monitoring concept and various domains of application will be presented and exemplified with case studies.

Lecture 8, "Technology Trend Monitoring Methods and Software Applications" will describe commonly used tools and quantitative and qualitative techniques for the implementation of the Technology Trend Monitoring work. A number of software applications, which have been developed to monitor technologies will also be presented during this lecture.

Lecture 9, "HSE Technology Trend Monitoring Approach: The Case of Semantic Technologies" will present the Technology Trend Monitoring approach developed at the Higher School of Economics and demonstrated in the semantic technologies area.

Lecture 10, "Integrating the results of Foresight and Technology Monitoring into public 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.

Lectures will be followed by seminars on the "Practical Applications of Foresight and Technology Monitoring in the ICTs". During the seminars the students will exercise a practical Foresight study on a predefined ICT related technology, a specified ICT related social dimension or an application. 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 and a roadmap for implementation.

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

5. Thematic Plan

a) Lectures and seminars for the Bachelor programme:

Lectures

Topics	Lectures (class hours	Self study	Total academic hours
1. Introduction to Foresight: Concepts and Approaches	4	1	5
2. Foresight methodology and frequently used methods	4	1	5
3. Applications of Foresight in the field of the ICTs	4	1	5
4. Quantitative and qualitative methods for Technology Monitoring	4	1	5
5. Monitoring Technologies in the ICTs	4	1	5
6. Technology and market dynamics in the ICTs sector: The case of Russia	4	1	5
7. Roadmapping for Technologies and Markets in the ICTs	4	1	5
8. Formulating strategies and actions for the ICTs	4	1	5
total	*32*	*8*	*40*

Seminars

Topics	Seminar (class hours)	Self study	Total academic hours
Introduction presentation on the "Practical applications of Foresight and Trend Monitoring in the ICTs"	2		2
Student work		2	2
Consultations		1	1
Presentations and discussions	4		4
total	*6*	*3*	*9*

b) Lecture topics for the Masters programme:

Lectures

Topics	Lectures (class hours)	Self study	Total academic hours
1. Foresight: Evolution of the practice	4	1	5
2. Global Practices and Processes of Foresight	4	1	5
3. Overview of Key Foresight Methods: Horizon Scanning, Scenarios, Delphi and Roadmaps	4	1	5
4. Global Megatrends and Grand Challenges	4	1	5
5. The Role of ICTs to Address Grand Challenges and Socio-Economic Prosperity	4	1	5
6. ICTs in BRIC Countries: Foresight, Policies and Priorities	4	1	5
7. Monitoring Technology Trends: Definitions, Application Domains, Case Studies	4	1	5
8. Technology Trend Monitoring Methods and Software Applications	4	1	5
9. HSE Technology Trend Monitoring Approach: The Case of Semantic Technologies	4	1	5
10. Integrating the Results of Foresight and Technology Monitoring into Public STI Policy and Business R&D Planning	4	1	5
total	*40*	*10*	*50*

Seminars

Topics	Seminar (class hours)	Self study	Total academic hours
Introduction presentation on the "Practical applications of Foresight and Trend Monitoring in the ICTs"	2		2
Student work		2	2
Consultations		1	1
Presentations and discussions	4		4
total	*6*	*3*	*9*

TOTAL (Bachelors + Masters): 108 hours

6. Time Plan

a) Lectures and seminars for Bachelors programme

Lectures

Topics	date
Introduction to Foresight: Concepts and Approaches	tbc
Foresight methodology and frequently used methods	tbc
Applications of Foresight in the field of the ICTs	tbc
Quantitative and qualitative methods for Technology Monitoring	tbc
Monitoring Technologies in the ICTs	tbc
Technology and Market dynamics in the ICTs: The case of Russia	tbc
Roadmapping for Technologies and Markets in the ICTs	tbc
Formulating strategies and actions for the ICTs	tbc

Seminars

Topic	date
Introduction presentation	tbc
Presentations and discussions	tbc

b) Lectures and seminars for the Masters programme

Lectures

Topics	date
Foresight: Evolution of the practice	tbc
Global Practices and Processes of Foresight	tbc
Overview of Key Foresight Methods: Horizon Scan-ning, Scenarios, Delphi and Roadmaps	tbc
Global Megatrends and Grand Challenges	tbc
The Role of ICTs to Address Grand Challenges and Socio-Economic Prosperity	tbc
ICTs in BRIC Countries: Foresight, Policies and Priori-ties	tbc
Monitoring Technology Trends: Definitions, Applica-tion Domains, Case Studies	tbc
Technology Trend Monitoring Methods and Software Applications	tbc
HSE Technology Trend Monitoring Approach: The Case of Semantic Technolo-gies	tbc
Integrating the Results of Foresight and Technology Monitoring into Public STI Policy and Business R&D Planning	tbc

Seminars

Topics	date
Introduction presentation	tbc
Presentations and discussions	tbc

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**

a) Lectures for the Bachelors programme

Lecture 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 - 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).

Lecture 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/unidocoursecriticaltechnologies10291_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 - 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 - 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.

Lecture 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 - 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 – 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 - last visited on January 15, 2012).

Lecture 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.
- NASA (2011). "Technology Readiness Levels definitions", Available at: 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

Lecture 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 - last visited on January 13, 2011).
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Lecture 6   Technology and market dynamics in the ICTs sector: The case of Russia

Topic outline:
- Trends in the ICTs sector
- Technology supply dynamics
- Market demand dynamics
- Developments in the Russian ICT sector
- Russian national ICT policies and priorities

Main references/books/reading:
- International Telecommunications Union Publications. Available at: http://www.itu.int/ITU-D/ict/publications/
- Misuraca, G., Broster, D. and Centeno, C. (2012). Digital Europe 2030: Designing scenarios for ICT in future governance and policy making, "Government Information Quarterly", vol. 29, pp. S121-S131.
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- ISTOK-SOYUZ (2009). "National ICT Sector and Policy Appraisal Report", ISTOK: Information Society Technologies to Open Knowledge for Eastern Europe and Central Asia. Available at: http://www.eeca-ict.eu/uploads/dmdocuments/National_report_Russia_Final.pdf - last visited on: June 08, 2012.
- Mashkina, D., Ivanova, D. and Hanhisalo, I. (2010). "Finnote ICT RIC Study: Russia Executive Summary", Finpro & Tekes. Available at: http://www.tekes.fi/fi/gateway/PTARGS_0_201_403_994_2095_43/http%3B/tekes-ali1%3B7087/publishedcontent/publish/programmes/verso/documents/russia_ict_ric_study_executive_summary_jan2010.pdf - last visited on June 08, 2012.
- Picture (2011). "Updated report about the ICT R&D priorities in Russia", Picture - Policy dialogue in ICT to an Upper level for Reinforced EU-EECA Cooperation (FP7 project, No: 288279). Available at: http://www.eeca-ict.eu/uploads/new_documents/ICT_RD_Priorities_in_Russia_Apr_2012.pdf - last visited on: June 08, 2012.
- Research and Markets (2011). "Russia IT Industry Analysis", RNCOS E-Services Private Limited. Available at: http://www.researchandmarkets.com/research/3d9135/russia_it_industry - last visited on: June 08, 2012.

Lecture 7   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:
- Richey, J.M. and Grinnell, M. (2004). Evolution of roadmapping at Motorola, "Research-Technology Management", vol. 47, issue 2, pp. 37-41.
- Kostoff, R.N., Boylan, R. and Simons, G.R. (2004). Disruptive technology roadmaps, "Technological Forecasting and Social Change", vol. 71, 141-159
- Phaal, R. (2010). "Roadmapping Bibliography", Centre for Technology Management, University of Cambridge (Available at: http://www-mmd.eng.cam.ac.uk/ctm/trm/documents/roadmap_biblio10_9_09.pdf - last visited on Januaty 15, 2012).
- 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.

Lecture 8   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.
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- 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.
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- 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.

b) Lectures for the Masters programme

Lecture 1   Foresight: Evolution of the practice

Topic outline:

- Evolution of Foresight
- Foresight scope and coverage
- Current practice and methodological requirements for the future

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.
- 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.
- UNIDO Technology Foresight Manual (available on: http://www.unido.org/index.php?id=o5216 last visited on January 15, 2012).

Lecture 2   Global Practices and Processes of Foresight

Topic outline:

- Review of global Foresight practice
- International, national, regional and corporate Foresight cases
- Benchmarking of Foresight practices

Main references/books/reading:

- 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).
- Loveridge, D., Cuhls, K., Keenan, M. and Nedeva, M. (2001). "The practice of national Foresight programmes: A new analytical framework", Ideas in Progress papers no.23, PREST, University of Manchester (Available at: https://phps.portals.mbs.ac.uk/Portals/49/docs/dloveridge/WP23_%20New_analytical.pdf Last visited on: April 18, 2012).
- UNIDO Technology Foresight Manual (available on: http://www.unido.org/index.php?id=o5216 last visited on January 15, 2012).

Lecture 3   Overview of Key Foresight Methods: Horizon Scanning, Scenarios, Delphi and Roadmaps

Topic outline:

- Typology for Foresight Methods
- Horizon Scanning
- Scenarios
- Delphi survey
- Roadmaps

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.
- Kostoff, R.N., Boylan, R. and Simons, G.R. (2004). Disruptive technology roadmaps, "Technological Forecasting and Social Change", vol. 71, 141-159
- 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 - last visited on January 13, 2012).
- 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
- 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 - last visited on: January 15, 2012).
- 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.
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- van der Heijden, K. (1998). "Scenarios: the Art of Strategic Conversation", John Wiley.

Lecture 4   Global Megatrends and Grand Challenges

Topic outline:

- Major developments in social, technological, economic, environmental, political domains
- Global Megatrends
- Grand Challenges
- Implications megatrends and challenges for the future

Main references/books/reading:

- DEFRA (2002). DEFRA's Horizon Scanning Strategy for Science, Science Directorate, Science Strategy Team, UK (Available at: www.cgee.org.br/atividades/redirKori/284 Last visited on April 18, 2012).
- Health Canada (2007). External Environmental Scan, Department of Health, Ottawa.
- Glenn, J.C., Gordon, T.J., and Florescu, E. (2010). State of the Future, Millennium Project, www.stateofthefuture.org.
- Saritas, O. and Smith, J.E. (2011). The Big Picture – trends, drivers, wild cards, discontinuities and weak signals, "Futures", vol. 43, pp. 292-312.
- Articles on TechCast – A virtual think tank tracking the technology revolution (Available at: www.techcast.org).

Lecture 5   The Role of ICTs to Address Grand Challenges and Socio-Economic Prosperity

Topic outline:

- Role of Information and Communication Technologies to overcome the Grand Challenges
- ICTs for quality of life and wealth generation
- Advancements in the ICT technologies and emerging market demands

Main references/books/reading:

- Chuberre, N. and Liolis, K. (2010). "ISI Contribution to Grand Societal Challenges", Integral SatCom Initiative, European Technology Platform. Available at: http://ec.europa.eu/invest-in-research/pdf/download_en/isi_contribution.pdf - last visited on: June 09, 2012.
- EC (2011). "Key Enabling Technologies", High Level Expert Group on Key Enabling Technolgies, Final Report, European Commission, Brussels. Available at: http://ec.europa.eu/enterprise/sectors/ict/files/kets/hlg_report_final_en.pdf - last visited on: June 09, 2012.
- eMobility (2010). "eMobility Contributions to Solve Grand Societal Challenges", eMobility Technology Platform White Paper. Available at: http://www.ist-emobility.org/documents/EuropeanCommission/eMobility%20position%20paper_Grand%20societal%20challenges.pdf – last visited on: June 09, 2012.

Lecture 6   ICTs in BRIC Countries: Foresight, Policies and Priorities

Topic outline:

- ICTs in BRIC Countries:
- SWOT analysis of BRICs
- BRICs ICTs Policies and Priorities

Main references/books/reading:

- Brasscom (2010). "Brazilian IT Industry Overview 2010", Available at: http://www.scribd.com/doc/56813682/Brazil-IT-Industry-Overview-2010 - last visited on: June 08, 2012.
- Finpro, Tekes and Verso-program (2010). "China Runway: Guide for ICT Companies". Available at: www.tekes.fi/en/document/45388/china_runway_pdf - last visited on: June 08, 2012.
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- KPMG (2008). "The Indian ICT Industry: Enabling Global Competitiveness and Driving Innovation with Equitable Growth". Available at: http://www.kpmg.com.edgekey.net/IN/en/IssuesAndInsights/ArticlesPublications/Documents/The%20Indian%20ICT%20industry%20-%20Enabling%20Global%20Competitiveness%20and%20Driving%20Innovation%20with%20Equitable%20Growth.pdf – last visited on June 08, 2012.
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- Netherlands Agency, Ministry of Foreign Affairs (2011). "China ICT sector", summarized fiche, Available at: http://china.nlambassade.org/binaries/content/assets/postenweb/c/china/zaken-doen-in-china/sectoren/ict/china---ict-sector---2011-10-17.pdf - last visited on: June 08, 2012.
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- Proideal (2009). "ICT priorities in Latin America", Promotion of ICT Dialogue between Europe and America Latina, FP7 project (No. 231730). Available at: http://www.ubique.org/pro-ideal/Results/D1.2_Report_on_ICT_priorities_in_LA.pdf - last visited on: June 08, 2012.
- Research and Markets (2011). "Russia IT Industry Analysis", RNCOS E-Services Private Limited. Available at: http://www.researchandmarkets.com/research/3d9135/russia_it_industry - last visited on: June 08, 2012.
- Synchroniser (2012). "Indian ICT Priorities", Synchroniser: Enhancing the impact of EU-India ICT policy dialogue (FP7 project). Available at:

http://euroindiaresearch.org/synchroniser/ICTResearchPriorities.htm - last visited on: June 08, 2012.

Lecture 7   Monitoring Technology Trends: Definitions, Application Domains, Case Studies

Topic outline:

- Technology Trend Monitoring
- Trend monitoring application domains
- Trend Monitoring case examples at the national, industrial and corporate levels

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).
- 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 - last visited on January 13, 2011).

Lecture 8   Technology Trend Monitoring Methods and Software Applications

Topic outline:

- Commonly used tools for trend monitoring
- Quantitative and qualitative techniques
- Software applications for monitoring technologies

Main references/books/reading:

- Carrot2 – text and search results clustering framework. Available at: http://project.carrot2.org/
- Vantage Point - patent analysis, text mining and technology planning software. Available at: http://www.thevantagepoint.com/
- Thomson Data Analyzer – enables complex analysis on patent information, scientific publications and news. Available at: http://thomsonreuters.com/products_services/legal/legal_products/a-z/thomson_data_analyzer/

Lecture 9   HSE Technology Trend Monitoring Approach: The Case of Semantic Technologies

Topic outline:

- Higher School of Economics Technology Trend Monitoring Approach
- HSE methodology concept and steps
- Application of HSE methodology in semantic technologies

Main references/books/reading:

- 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).
- 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.
- 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).

Lecture 10 Integrating the results of Foresight and Technology Monitoring into public STI policy 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:
- 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.
- 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.
- Flanagan, K., Uyarra, E., Laranja, M. (2011). Reconceptualising the 'policy mix' for innovation, "Research Policy", 40, 5, 702-713.

- 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.
- Markard, J. and Truffer, B. (2008). Technological innovation systems and the multi-level perspective: Towards an integrated framework, "Research Policy", 37(4), 596-615.
- 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.
- 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.

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