National Research University Higher School of Economics

Syllabus

Measurement Of Science, Technology And Innovation (1st Year)
(3 ECTS)

Approved by
Academic Council
of the Master's Programme
Minutes 05122017/AC1

Author, lecturer (e-mail, web page):
Konstantin Fursov (ksfursov@hse.ru, https://www.hse.ru/en/staff/fursov)
Valeriya Vlasova (vvvlasova@hse.ru, https://www.hse.ru/en/org/persons/46697442)
Ekaterina Streltsova (kstreltsova@hse.ru, https://www.hse.ru/en/staff/streltsova)
Stanislav Zaichenko (szaichenko@hse.ru, https://www.hse.ru/en/org/persons/414998)
Vitaly Roud (vroud@hse.ru, https://www.hse.ru/en/staff/vroud)
Course director:
Konstantin Fursov

1. Corse Description

The course is delivered to master students of The National Research University Higher School of Economics. It is delivered in one module. The course length is 228 academic hours in total of which 60 hours are class room hours for lectures and seminars and 168 hours are devoted to self study.

a. Pre-requisites

No pre-requisites

b. Abstract

Decision-making in the STI domain requires evidence expressed in various indicators for measuring key aspects of generation and dissemination of new scientific and technical knowledge for innovation development and sustainable economic growth. Understanding of such indicators is important to explain how national STI systems are functioning in order to provide better evidence for better policies and informed decision-making. The course introduces the basic approaches and methodologies to design measurement concepts, elaboration of indicators, approaches to data collection and finally interpretation and analysis of the results. A strong focus is made on the international standards and best national practices of STI measurement. Such include analysis of R&D inputs and outputs, technological and non-technological innovation, scientometrics, etc. Moreover, course is complemented with a review of recent initiatives in indicator development and vision of the future development of STI studies.

c. Course language

English

2. Learning objectives

- Provide students with basic knowledge on international standards, methodology and best practices of STI statistics.
- Develop abilities of collection and interpretation of policy relevant data for evidence-based decision-making.

3. Learning outcomes (competencies)

- Knowledge of international standards in STI statistics and its domains
- Knowledge of methods used for collection of statistical data on STI
- Ability to select relevant data sources and construct main STI indicators
- Abilities for choosing appropriate data sources and indicators for analysis of STI development and use these results for policy advice
- Abilities to make effective searches in citation and patent databases

4. Course Plan

The course spans two academic modules. The teaching is based on selected writings and experiences of faculty members. In addition, selected reputed scholars and experts are invited bringing together views from different perspectives on the meaning of statistical indicators for science, technology and innovation to provide in-depth learning opportunities for all students.

Lectures are designed to deliver theoretical frameworks and international experiences. The course is accompanied by seminars, some sessions will feature additional foreign experts.

a. Lectures

Section	Topic
Introduction	An overview of STI statistics and indicators
R&D statistics	R&D statistics
	Measurement of human resources in science and technology
Scientometrics	Measurement of R&D outputs
	Basics of bibliometric indicators
	Indicators of intellectual property rights
Mid-term test	
Technology statistics	Statistics on technology
	Statistics on Information Society
	Measurement of technology intensity and international trade
Innovation statis-	Innovation statistics

tics	New areas for innovation measurement
Practical applications	Analysis and interpretation of statistical data

b. Seminars

Accompanying seminars introduce and develop new abilities of using different sources of information and tools for constructing statistical indicators, data analysis and interpretation.
Seminars consist of practical sessions, group tasks and short presentations on the issues considered in the course or master-classes that will provide students indispensable abilities for measuring science, technology and innovation issues.
During seminars, students will learn how to construct indicators, make effective searches in citation and patent databases, and give interpretation to the measurement results. In addition, they will learn about different sources of statistical information used in STI studies.

5. Reading List

1. An overview of STI statistics and indicators

Statistical studies of STI are based on the complex approach to the measurement of components that constitute national systems of knowledge production and innovation development in accordance with their role in the economy. The lecture introduces the scope and history of STI measurement; it draws a line around its basic principles and international standards in the field and provides links to other areas of statistics.

- The basics: national innovation system, linear/non-linear model of innovation, R&D
- Scope of STI statistics (e.g. types of STI activities)
- History of STI statistics
- Basic principles of STI measurement
- International standards for STI statistics
- STI within the framework of general statistics

a. Basic literature:

1) Gault, F. (ed.) (2013). Handbook of Innovation Indicators and Measurement. Cheltenham, UK: Edward Elgar.
URL: https://www.elgaronline.com/view/9780857933645.xml (accessed 31.08.2018).

2) B. Godin (2009). The Making of Science, Technology and Innovation Policy: Conceptual Frameworks as Narratives, 1945-2005. Montreal: Centre – Urbanisation Culture Société de l'Institut national de la recherche scientifique.
URL: http://www.csiic.ca/PDF/TheMakingOfScience.pdf (accessed 31.08.2018).

3) Godin, B. (2006). The linear model of innovation: The historical construction of an analytical framework. Science Technology and Human Values, 31(6), 639–667.
URL: https://doi.org/10.1177/0162243906291865 (accessed 31.08.2018).

b. Additional literature:

1) Godin, B. (2006). Measurement and Statistics on Science and Technology: 1920 to the Present. London: Routledge.

2) Gokhberg, L. (2002). Science and technology indicators in Russia and the European Union. Luxembourg: Eurostat.

2. R&D statistics

The internationally recognized methodology for collecting and using R&D statistics, the Frascati Manual is a widely accepted essential tool for statisticians worldwide. It includes definitions of basic concepts, data collection guidelines, and classifications for compiling statistics. The lecture introduces basic guidelines for measurement of R&D provided in the FM and implementation of the introduced principles at national and international levels.

- Measurement needs and methodological framework
- OECD Frascati Manual
- Basic definitions and conventions
- Classifications
- R&D personnel
- R&D expenditure
- National and international R&D surveys

a. Basic literature:

1) OECD (2015). Frascati Manual: Guidelines for Collecting and Reporting Data on Research and Experimental Development. Paris, OECD.
URL: https://read.oecd-ilibrary.org/science-and-technology/frascati-manual-2015_9789264239012-en# (accessed 31.08.2018).
2) OECD (2017). OECD Science, Technology and Industry Scoreboard 2017: The Digital Transformation. OECD Publishing.
URL: https://read.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-scoreboard-2017_9789264268821-en#page1 (accessed 31.08.2018).
3) OECD Main Science and Technology Indicators Database. Paris, OECD.
URL: https://www.oecd-ilibrary.org/science-and-technology/data/oecd-science-technology-and-r-d-statistics_strd-data-en (accessed 31.08.2018).

b. Additional literature:

1) Gokhberg, L. (2002). Science and technology indicators in Russia and the European Union. Luxembourg: Eurostat.
2) UNESCO (2015). *UNESCO Science Report: Towards 2030*. UNESCO Publishing.
URL: http://unesdoc.unesco.org/images/0023/002354/235406e.pdf (accessed 31.08.2018).

3. Measurement of human resources in science and technology

With the recognition of S&T as an important source of innovation and growth, the need to ensure the adequate supply and career management of R&D and other categories of personnel engaged in scientific performance became one of the key points in the organization of national research systems. The lecture provides an overview of different methodological frameworks that are at hand to help produce relevant sets of data on stock and flows of human resources in science and technology (HRST) as well as indicators on their demographic, career, mobility or skill characteristics.

- Definitions and classifications
- Measuring stock and flows of HRST

- International surveys on careers and mobility of doctorate holders
- Measuring abilities for innovation

a. Basic literature:

1) OECD (2015). Frascati Manual: Guidelines for Collecting and Reporting Data on Research and Experimental Development. Paris, OECD.
URL: https://read.oecd-ilibrary.org/science-and-technology/frascati-manual-2015_9789264239012-en# (accessed 31.08.2018).
2) OECD/Eurostat (1995). Measurement of Scientific and Technological Activities: Manual on the Measurement of Human Resources Devoted to S&T – Canberra Manual. OECD Publishing.
URL: https://doi.org/10.1787/9789264065581-en (31.08.2018).
3) Gokhberg, L., Shmatko, N.A., Auriol, L. (2016). The Science and Technology Labor Force: The Value of Doctorate Holders and Development of Professional Careers. Springer International Publishing, Switzerland.
URL: https://link.springer.com/book/10.1007/978-3-319-27210-8 (accessed 31.08.2018).

b. Additional literature:

1) Auriol, L., M. Misu and R. Freeman (2013). Careers of Doctorate Holders: Analysis of Labour Market and Mobility Indicators. OECD Science, Technology and Industry Working Papers, No. 2013/04, OECD Publishing, Paris.
URL: https://doi.org/10.1787/5k43nxgs289w-en (accessed 31.08.2018).
2) Auriol, L., M. Schaaper and B. Felix (2012). Mapping Careers and Mobility of Doctorate Holders: Draft Guidelines, Model Questionnaire and Indicators – Third Edition. OECD Science, Technology and Industry Working Papers, No. 2012/07, OECD Publishing.
URL: https://search.proquest.com/openview/5edb4bc09880c6bcbf735030a7c3c5f6/1?pq-origsite=gscholar&cbl=54496 (accessed 31.08.2018).
3) Auriol, L. (2010). Careers of Doctorate Holders: Employment and Mobility Patterns. OECD Science, Technology and Industry Working Papers, No. 2010/04, OECD Publishing.
URL: https://www.oecd-ilibrary.org/docserver/5kmh8phxvvf5-en.pdf?expires=1548513008&id=id&accname=guest&checksum=BEA280BDE407F9F860178D133B96198C (accessed 31.08.2018).

4. Measurement of R&D outputs

Measuring R&D performance is often associated with assessment of publication and patent activity of research organizations, social groups or individuals. Wider implementation of this approach follows well-established traditions in this field of studies as well as growing demand from policymakers for particular indicators of R&D output. Other characteristics of scientific production (infrastructure capabilities, technology, innovation, social impacts, etc.) are put aside as a self-contained topic. On the other hand, professional discussions on statistical measurement of R&D until recently put aside the problem of accounting for scientific outputs. The lecture is aimed at building a bridge between these traditions and reflecting the scope for measuring scientific performance in general and R&D outputs in particular.

- Scope of measuring R&D outputs

- Scientometrics and other methods for measuring scientific performance

a. Basic literature:

1) Freeman C., ed. (1987). Output Measurement in Science and Technology: Essays in Honor of Yvan Fabian, Elsevier Science Publishers B.V., Amsterdam.
URL: https://www.sciencedirect.com/book/9780444703309/output-measurement-in-science-and-technology (accessed 31.08.2018).
2) García-Valderrama, T., & Mulero-Mendigorri, E. (2005). Content validation of a measure of R&D effectiveness. R and D Management, 35(3), 311–331.
URL: https://doi.org/10.1111/j.1467-9310.2005.00392.x (accessed 31.08.2018).
3) Godin, B. (2006). On the origins of bibliometrics. Scientometrics, 68(1), 109–133.
URL: http://www.csiic.ca/PDF/Godin_33.pdf (accessed 31.08.2018).

b. Additional literature:

1) Coccia, M. (2004). New models for measuring the R&D performance and identifying the productivity of public research institutes. R and D Management, 34(3), 267–280.
URL: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2577984 (accessed 31.08.2018).
2) Lyall, C., Bruce, A., Firn, J., Firn, M., & Tait, J. (2004). Assessing end-use relevance of public sector research organisations. Research Policy, 33(1), 73–87.
URL: https://www.sciencedirect.com/science/article/abs/pii/S0048733303000908 (accessed 31.08.2018).

5. Basics of bibliometric indicators

Bibliometrics combines a variety of methods allowing to measure research outputs and to analyze social structures of scientific production. Its tools are useful for research evaluation, comparing sciences, understanding tendencies of scientific growth, etc. The lecture gives an introductory overview of the principles of bibliometric analysis, usage of key indicators and recommendations for using data sources.

- Indicators and methods
- Data sources: an overview
- Using bibliometric databases
- Data analysis and interpretation

a. Basic literature:

1) Bar-Ilan, J. (2008). Informetrics at the beginning of the 21st century—A review. Journal of Informetrics, (1), 1–52.
URL: https://www.sciencedirect.com/science/article/abs/pii/S1751157707000740 (accessed 31.08.2018).
2) Bellis, N. (2009). Bibliometrics and Citation Analysis: From the Science Citation Index to Cybermetrics. Scarecrow Press.
URL: https://selembarpapyrus.com/wp-content/uploads/2017/09/Bibliometrics-and-Citation-Analysis-Nicola-de-Bellis.pdf (accessed 31.08.2018).

3) Hicks, D., Wouters, P., Waltman, L., de Rijcke, S., & Rafols, I. (2015). bibliometrics: The Leiden Manifesto for research metrics. Nature, 520(7548), 429-431.
URL: https://www.nature.com/polopoly_fs/1.17351!/menu/main/topColumns/topLeftColumn/pdf/520429a.pdf?origin=ppub (accessed 31.08.2018).
4) Moed H. et al. (2004). Handbook of Quantitative Science and Technology Research. Kluwer academic publishers.
URL: https://pdfs.semanticscholar.org/60c3/e307aed05dbee13a5448c7b48b1289d3fccf.pdf (accessed 31.08.2018).

b. Additional literature:

1) Gingras, Y. (2016). Bibliometrics and research evaluation: Uses and abuses. MIT Press.
2) Garfield, E. (1979). Is citation analysis a legitimate evaluation tool? Scientometrics, 1(4), 359–375.
URL: https://link.springer.com/article/10.1007/BF02019306 (accessed 31.08.2018).
3) Garfield, E., Sher, I. H., & Torpie, R. J. (1964). The use of citation data in writing the history of science. DTIC Document.
URL: www.garfield.library.upenn.edu/papers/useofcitdatawritinghistofsci.pdf (accessed 31.08.2018).
4) Igami, M. and A. Saka (2007). Capturing the Evolving Nature of Science, the Development of New Scientific Indicators and the Mapping of Science. OECD Science, Technology and Industry Working Papers, 2007/1, OECD Publishing.
URL: https://www.oecd-ilibrary.org/docserver/300005636714.pdf?expires=1548515303&id=id&accname=guest&checksum=424E74B80BD95E311CE4B3A8D1FF857A (accessed 31.08.2018).
5) Okubo, Y. (1997). Bibliometric Indicators and Analysis of Research Systems: Methods and Examples. OECD Science, Technology and Industry Working Papers, 1997/1, OECD Publishing.
URL: http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=OCDE/GD(97)41&docLanguage=En (accessed 31.08.2018).
6) Price, D. J. S. (1979). Networks of Scientific Papers-The pattern of bibliographic references indicates the nature of the research front. The Scientific Journal, ed. Meadows, AJ, London: ASLIB, 157–162.
URL: http://garfield.library.upenn.edu/papers/pricenetworks1965.pdf (accessed 31.08.2018).

6. Indicators of intellectual property rights

The lecture is designed to provide students with basic theoretical and practice-oriented knowledge and abilities, needed to employ methods of patent analysis for various research tasks. It will discuss research potential of patent statistics, specify the key indicators used in Russian and global studies, provide brief and comprehensive instructions for patent information' user.

Key topics:

- Types of IP
- Indicators of IP stock and flows
- Patent databases
- Analysis of patent statistics

a. Basic literature:

1) OECD (2009). Patent Statistics Manual. Paris, OECD. Chapters 2, 5.
URL: https://www.oecd-ilibrary.org/science-and-technology/oecd-patent-statistics-manual_9789264056442-en?_ga=2.144710388.1110762815.1548511417-2109889095.1504430158 (accessed 31.08.2018).
2) Archibugi D. (1992) Patenting as an indicator of technological innovation: a review. Science and Public Policy. Vol.19 (1). P.357 – 368.
URL: https://doi.org/10.1093/spp/19.6.357 (accessed 31.08.2018).

b. Additional literature:

1) Archibugi D., Pianta M. (1996) Measuring technological change through patents and innovation surveys. Technovation, Vol.16 (9). P. 451 – 468.
URL: http://www.danielearchibugi.org/downloads/papers/2017/11/Archi-Pianta_Technovation.pdf (accessed 31.08.2018).
2) Jenkins D. (2004) The Industrial Application of Patent Analysis: an Empirical Study. Bourthmouth: Bournemouth University. Chapter 2.
URL: http://eprints.bournemouth.ac.uk/3719/ (accessed 31.08.2018).
3) OECD (2006) Glossary on Patent Terminology. Paris: OECD.
URL: https://stats.oecd.org/glossary/detail.asp?ID=2023 (accessed 31.08.2018).
4) Schmoch, U. (2008) Concept of a technology classification for country comparisons. Final report to the World Intellectual Property Organisation (WIPO), Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, Germany.
URL:
https://www.wipo.int/export/sites/www/ipstats/en/statistics/patents/pdf/wipo_ipc_technology.pdf (accessed 31.08.2018).

7. Statistics on technology

There is a widespread and increasing interest in the development of indicators for measuring technology development, dissemination and social and economic impacts. Though over the last 50 years relevant statistics allowing for standardized and internationally harmonized measurement of S&T have been established, there is still lack of knowledge on how technologies could be measured. The lecture summarizes international state of the art in technology measurement and introduces elements of an integrated approach for technology measurement.

- Scope of statistics on technology
- Statistics on advanced manufacturing technologies
- Biotechnology statistics
- Nanotechnology statistics

a. Basic literature:

1) Cozzens, S., Gatchair, S., Kang, J., Kim, K.-S., Lee, H. J., Ordóñez, G., & Porter, A. (2010). Emerging technologies: quantitative identification and measurement. Technology Analysis & Strategic Management, 22(3), 361–376.
URL: https://pdfs.semanticscholar.org/c666/401c624e61c2d6f411b67ab30b034ef651b4.pdf (accessed 31.08.2018).
2) Gokhberg, L., Fursov, K., Miles, I., & Perani, G. (2013). Developing and using indicators of emerging and enabling technologies. In F. Gault (Ed.) Handbook of Innovation Indicators and Measurement. Cheltenham: Edward Elgar Publishing Ltd., 349-380.
URL: https://www.elgaronline.com/view/9780857933645.xml (accessed 31.08.2018).
3) Marx, L. (2010). Technology: the emergence of a hazardous concept. Technology and Culture, 51(3), 561–77.
URL: https://www.jstor.org/stable/pdf/40927986.pdf?seq=1#page_scan_tab_contents (accessed 31.08.2018).
4) OECD (2009). Biotechnology Statistics. Paris, OECD.
URL: https://www.oecd.org/sti/42833898.pdf (accessed 31.08.2018).
5) Palmberg C., Dernis H., Miguet C. (2009). Nanotechnology: an Overview Based on Indicators and Statistics. STI Working Paper, DSTI/DOC(2009)7. Paris, OECD.
URL: https://www.oecd-ili-brary.org/docserver/223147043844.pdf?expires=1548516011&id=id&accname=guest&checksum=577A74C74414B260C994EDA7F5DDE991 (accessed 31.08.2018).

b. Additional literature:

1) Freeman, C. (1998). The economics of technical change. Trade, Growth and Technical Change, Cambridge, 16–54.
URL: https://www.jstor.org/stable/24231814 (accessed 31.08.2018).
2) OECD (2010). The Impacts of Nanotechnology on Companies: Policy Insights from Case Studies, OECD Publishing.
URL: https://www.oecd-ilibrary.org/science-and-technology/the-impacts-of-nanotechnology-on-companies_9789264094635-en (accessed 31.08.2018).
3) Schatzberg, E. (2006). Technik comes to America: changing meanings of technology before 1930, Technology and Culture, 47(3), 486–512.
URL: https://www.jstor.org/stable/40061169?seq=1#page_scan_tab_contents (accessed 31.08.2018).

8. Statistics on Information Society

The lecture introduces key principles and best practices in measuring Information Society, i.e. ICT supply and demand, infrastructure, usage by businesses, households and individuals, e-abilities. It starts with an overview of basic definitions of and international statistical standards (OECD, Eurostat, ITU) and continues with approaches to construction and use of indicators to measure different aspects of Information Society development.

- Scope of statistics on Information Society
- Statistics on the ICT sector
- Statistics on ICT use in the economy

- Measuring ICT use in households and by individuals, e-abilities
- Statistics on e-government

c. Basic literature:

1) Eurostat (2013). Methodological Manual for Statistics on the Information Society. EC, Eurostat.
URL: https://ec.europa.eu/eurostat/documents/3859598/5896837/KS-BG-06-004-EN.PDF/9cf80df6-415c-447b-b107-be97aa339a73?version=1.0 (accessed 31.08.2018).
2) ITU (2011). Handbook for the Collection of Administrative Data on Telecommunications/ICT. Geneva, ITU.
URL: https://www.itu.int/en/ITU-D/Statistics/Pages/publications/handbook.aspx (accessed 31.08.2018).
3) ITU (2014). Manual for Measuring ICT Access and Use by Households and Individuals. Geneva, ITU.
URL: http://www.itu.int/pub/D-IND-ITCMEAS-2014 (accessed 31.08.2018).
4) OECD (2011). Guide to Measuring the Information Society. Paris, OECD.
URL: https://read.oecd-ilibrary.org/science-and-technology/oecd-guide-to-measuring-the-information-society-2011_9789264113541-en#page1 (accessed 31.08.2018)
5) UNCTAD (2009). Manual for the Production of Statistics on the Information Economy. Geneva, UNCTAD.
URL: https://unctad.org/en/pages/PublicationWebflyer.aspx?publicationid=1079 (accessed 31.08.2018).

a. Additional literature::

1) OECD (2019). Vectors of digital transformation. OECD Digital Economy Papers, No. 273, OECD Publishing, Paris.
URL: https://doi.org/10.1787/5ade2bba-en (accessed 31.08.2018).
2) OECD (2017), OECD Digital Economy Outlook 2017, OECD Publishing, Paris.
URL: https://doi.org/10.1787/9789264276284-en (accessed 31.08.2018).
3) OECD (2013). The Internet Economy on the Rise: Progress since the Seoul Declaration Outlook, Paris, OECD.
URL: http://www.oecd.org/internet/internet-economy-on-the-rise.htm (accessed 31.08.2018).

9. Measurement of technology intensity and trade

The lecture summarizes key principles for measuring technology intensity and trade in accordance with international standards and best practices in the area and include two subtopics.

9.1 Measuring technology intensity

In many countries high-tech sectors of economy and enterprises are key drivers of economic growth, productivity enhancement, efficient employment, and social development. This section is devoted to review of methods, metrics and available sources of statistical data for high technology analysis, as well as multiple ways of its application.

a. Basic literature:

Hatzichronoglou, T. (1997) Revision of the High-Technology Sector and Product Classification. URL: http://www.oecd-ilibrary.org/science-and-technology/revision-of-the-high-technology-sector-and-product-classification_134337307632 (accessed 31.08.2018).
High-tech statistics. EUROSTAT.
URL: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/High-tech_statistics (accessed 31.08.2018).

Additional literature:

ISIC REV. 3 Technology intensity definition (2011), OECD.
URL: http://www.oecd.org/dataoecd/43/41/48350231.pdf (accessed 31.08.2018).
UNIDO (2013): Industrial Development Report 2013. Sustaining Employment Growth: The Role of Manufacturing and Structural Change, UNIDO.
URL: http://www.unido.org/fileadmin/user_media/Research_and_Statistics/UNIDO_IDR_2013_main_report.pdf (accessed 31.08.2018).

9.2 Measurement of international technology trade

Technology balance of payments (TBP) remains one of the key indicators for measuring international technology trade. This section refers to the key definitions and methodology for calculation and interpretation of TBP data.

Key topics:

- TBP framework
- TBP transactions
- Interpreting TBP data

d. Basic literature:

1) OECD (2005). Handbook on Economic Globalisation Indicators. Paris, OECD.
URL: https://www.oecd-ilibrary.org/industry-and-services/measuring-globalisation-oecd-economic-globalisation-indicators-2005_9789264012394-en (accessed 31.08.2018).
2) IMF Balance of Payments Compilation Guide (1995). Washington, DC, USA: International Monetary Fund.
URL: https://www.imf.org/external/pubs/ft/bopcg/1995/bopcg.pdf (accessed 31.08.2018).

Additional literature:

1) Grosse, R. (1996). International Technology Transfer in Services. Journal of International Business Studies, 27, 781–800.
URL: https://link.springer.com/article/10.1057/palgrave.jibs.8490153 (accessed 31.08.2018).
2) Madhok, A. (1996). Know-how-, experience-and competition-related considerations in foreign market entry: An exploratory investigation. International Business Review, 5(4), 339–366.
URL: https://www.sciencedirect.com/science/article/abs/pii/0969593196000170 (accessed 31.08.2018).

3) Metz, B., & Turkson, J. K. (2000). Methodological and Technological Issues in Technology Transfer: A Special Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.
URL:
http://documentacion.ideam.gov.co/openbiblio/bvirtual/005133/ipcc/tectran/IPCC_SRTT.pdf (accessed 31.08.2018).
4) Rouach, D. (2003). Technology Transfer and Management-Guidance for Small and Mediumsized Enterprises'. Tech Monitor, 20(3), 21–28.
URL:
https://www.researchgate.net/publication/282069575_Selecting_the_appropriate_technology_transfer_method_to_reach_the_technology_localization (accessed 31.08.2018).

10. Innovation statistics

Innovation statistics is aimed at measuring new or significantly improved goods or services, technological, organizational, ecological or other advances as well as their role in economic development. The core definition of innovation for the use in statistical measurement was codified 20 years in the Oslo Manual to recognize new technological products and manufacturing processes. Since then its initial coverage was extended from manufacturing to the entire market economy. The lecture introduced basic methodological principles of innovation statistics as well as examples of their implementation at national and international levels.

- Methodological framework and measurement needs
- OECD Oslo Manual
- Basic definitions and conventions
- Classifications
- Measuring innovation activities
- Indicators on objectives, obstacles and outcomes of innovation
- National and international innovation surveys

a. Basic literature:

1) Fagerberg, J., Mowery, D.C. & Nelson, R.R. (2006). The Oxford Handbook of Innovation, Oxford University Press, USA.
2) Gault, F. (2010). Innovation strategies for a global economy development, implementation, measurement and management, Ottawa: International Development Research Centre.
URL: https://www.idrc.ca/en/book/innovation-strategies-global-economy-development-implementation-measurement-and-management (accessed 31.08.2018).
3) Gault, F. (ed.) (2013). Handbook of Innovation Indicators and Measurement. Cheltenham, UK: Edward Elgar.
URL: https://www.elgaronline.com/view/9780857933645.xml (accessed 31.08.2018).
4) OECD/Eurostat (2018). Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg.
URL: https://read.oecd-ilibrary.org/science-and-technology/oslo-manual-2018_9789264304604-en#page1 (accessed 10.12.2018).

5) Organisation for Economic Co-operation and Development (2009). Innovation in Firms: A Microeconomic Perspective. Paris: OECD.
URL: https://read.oecd-ilibrary.org/science-and-technology/innovation-in-firms_9789264056213-en#page1 (accessed 31.08.2018).

b. Additional literature::

1) Archibugi, D. (2001). Pavitt's taxonomy sixteen years on: a review article. Economics of Innovation and New Technology, 10(5), 415–425.
URL: https://www.tandfonline.com/doi/pdf/10.1080/10438590100000016 (accessed 31.08.2018).
2) Cohen, W.M. (2010). Fifty Years of Empirical Studies of Innovative Activity and Performance. In Handbook of the Economics of Innovation, Vol. 1. North-Holland, 129–213.
URL: https://www.sciencedirect.com/science/article/pii/S016972181001004X (accessed 31.08.2018).
3) Diamond, A.M. (2004). Zvi Griliches's contributions to the economics of technology and growth. Economics of Innovation and New Technology, 13(4), 365–397.
URL: https://www.tandfonline.com/doi/abs/10.1080/10438590410001629043 (accessed 31.08.2018).
4) Griliches, Z., Pakes, A. & Hall, B.H. (1988). The value of patents as indicators of inventive activity, National Bureau of Economic Research Cambridge, Mass.
URL: https://www.nber.org/chapters/c8351.pdf (accessed 31.08.2018).
5) Grupp, H. & Mogee, M.E. (2004). Indicators for national science and technology policy: how robust are composite indicators? Research Policy, 33(9), 1373–1384.
URL: https://www.sciencedirect.com/science/article/pii/S0048733304001180 (accessed 31.08.2018).
6) Pavitt, K. (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory. Research Policy, 13(6), 343–373.
URL: https://www.sciencedirect.com/science/article/pii/0048733384900180 (accessed 31.08.2018).

11. New areas for innovation measurement

Modern innovation studies go far beyond an enterprise perspective covering variety of actors and interactions between them. The aim of the lecture is to give an overview of these studies, providing a background for discussion on further development of innovation measurement.

- Service innovation
- Open innovation
- User innovation
- Public sector innovation
- Social innovation

a. Basic literature:

1) Arundel, A. and D. Huber (2013). From little to too much innovation? Issues in measuring innovation in the public sector. Structural Change and Economic Dynamics, Vol. 27.

URL: https://www.sciencedirect.com/science/article/pii/S0954349X13000611 (accessed 31.08.2018).
2) Chesbrough, H. (2012). Open Innovation. Research Technology Management, 55(4).
URL: http://eds.b.ebscohost.com/eds/detail/detail?vid=0&sid=992afbdd-e3eb-4e62-bc2e-6bcdaacc48d7%40pdc-v-sessmgr06&bdata=JnNpdGU9ZWRzLWxpdmU%3d (accessed 31.08.2018).
3) Hipp, C., & Grupp, H. (2005). Innovation in the service sector: The demand for service-specific innovation measurement concepts and typologies. Research Policy, 34(4), 517–535.
URL: https://www.sciencedirect.com/science/article/pii/S0048733305000417 (accessed 31.08.2018).
4) Murray, R., Caulier-Grice, J., Mulgan, J. (2010). The Open Book of Social Innovation. NESTA.
URL:
http://www.nesta.org.uk/sites/default/files/the_open_book_of_social_innovation.pdf (accessed 31.08.2018).
5) OECD (2010). Measuring Innovation: A New Perspective. OECD Publishing.
URL: https://www.oecd-ilibrary.org/science-and-technology/measuring-innovation_9789264059474-en?_ga=2.110705987.731819364.1548659744-1103589207.1457873498 (accessed 31.08.2018).
6) von Hippel E. (2017). Free Innovation. Cambridge, Massachusetts, USA: MIT Press.
URL: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2866571 (accessed 31.08.2018).

b. Additional literature::

1) Miles, I. (2010). Service Innovation. Handbook of Service Science, 511.
2) URL: https://link.springer.com/book/10.1007/978-1-4419-1628-0 (accessed 31.08.2018).
3) OECD (2012). OECD Observatory of Public Sector Innovation.
URL: http://www.oecd.org/governance/oecdobservatoryofpublicsectorinnovation.htm (accessed 31.08.2018).
4) OECD (2015). The Innovation Imperative: contributing to productivity, growth and well-being. Paris: OECD Publishing.
URL: https://read.oecd-ilibrary.org/science-and-technology/the-innovation-imperative_9789264239814-en#page1 (accessed 31.08.2018).
5) Phills Jr., J. A., Deiglmeier, K., & Miller, D. T. (2008). Rediscovering Social Innovation. Leland Stanford Jr. University.
URL:
http://www.ssireview.org/images/articles/2008FA_feature_phills_deiglmeier_miller.pdf (accessed 31.08.2018).

12. Analysis and interpretation of statistical data

Variety of statistical indicators on STI development require accurate analysis and explanation for advisory and policymaking at different levels. While manuals allow the ‘routines’ of data collection and interpretation, dynamic economic and social processes as well as specific policy needs require deeper understanding of the facts and tendencies behind the figures. The lecture is fo-

cused on available aggregate indicators used for international comparisons and rankings, main sources of information and future perspectives of STI measurement.

- Aggregate indicators and rankings
- International comparisons
- "Blue-sky" issues and the future of STI measurement

a. Basic literature:

1) Gault, F. (ed.) (2013). Handbook of Innovation Indicators and Measurement. Cheltenham, UK: Edward Elgar.
URL: https://www.elgaronline.com/view/9780857933645.xml (accessed 31.08.2018).

2) Graversen, E. K., & Siune, K. (2008). Statistical Indicators for R&D and Innovation-A guide for Interpretation and Valuation. Synthesis Report Deliverable. The Danish Centre for Studies in Research and Research Policy
URL: http://ps.au.dk/fileadmin/site_files/filer_forskningsanalyse/dokumenter/Diverse/D10_Guide_for_valuation.pdf (accessed 31.98.2018).

3) OECD (2007). Science, Technology and Innovation Indicators in a Changing World: Responding to Policy Needs. OECD Publishing.
URL: http://www.oecd.org/sti/inno/sciencetechnologyandinnovationindicatorsinachangingworldrespondingtopolicyneeds.htm (accessed 31.08.2018).

4) The Global Innovation Index 2018: Energizing the World with Innovation. Cornell SC Johnson College of Business, INSEAD, WIPO.
URL: https://www.wipo.int/publications/ru/details.jsp?id=4330 (accessed 31.08.2018).

5) National Science Board (2018). Science and Engineering Indicators 2018. Arlington VA: National Science Foundation.
URL: https://www.nsf.gov/statistics/2018/nsb20181/ (accessed 31.08.2018).

b. Additional literature::

1) A global perspective on science, technology and innovation (STI). UNESCO Institute for Statistics.
URL: http://www.uis.unesco.org/ScienceTechnology/Pages/default.aspx (accessed 31.08.2018).

2) OECD (2010). Measuring Innovation: A New Perspective. OECD Publishing.
URL: https://www.oecd-ilibrary.org/science-and-technology/measuring-innovation_9789264059474-en?_ga=2.110705987.731819364.1548659744-1103589207.1457873498 (accessed 31.08.2018).

3) OECD (2017). OECD Science, Technology and Industry Scoreboard 2017: The Digital Transformation. OECD Publishing.
URL: https://read.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-scoreboard-2017_9789264268821-en#page1 (accessed 31.08.2018).

4) OECD (2018). OECD Science, Technology and Innovation Outlook 2018: Adapting to Technological and Societal Disruption. OECD Publishing, Paris
URL: https://doi.org/10.1787/sti_in_outlook-2018-en (accessed 31.08.2018).

5) OECD (2017), OECD Digital Economy Outlook 2017, OECD Publishing, Paris. URL: https://doi.org/10.1787/9789264276284-en (accessed 31.08.2018).
6) UNESCO (2015). UNESCO Science Report: Towards 2030. UNESCO Publishing. URL: http://unesdoc.unesco.org/images/0023/002354/235406e.pdf (accessed 31.08.2018).

6. Grading system

The overall course grade G (10-point scale) is calculated by the formula:
G = 0.5*E + 0.2*S + 0.1*MTT + 0.2*HA,
and includes results achieved by students in their exam (*E)*, seminar *(S)*, mid-term test *(MTT)* and two home assignments *(HA)*; it 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

7. Course assignments

a. Home assignment (HA)

A home-prepared written task prepared within a week period on the topic announced in the middle or in the end of each lecture. HA are to be submitted by the beginning of the seminar coming a week after the task was announced. A student is asked to submit *two any* of the HAs during the course. One student can submit *no more than three* home tasks during the course on voluntary basis (two highest grades are taken into consideration for final grade calculation).
Format: mini-essay around 1000 words answering the question asked. HA (if not mentioned specifically) should include:

- a short introduction (why the issue matters);
- a reasoned (evidence-based) written reply to the question asked;
- a short conclusion (the main finding).

8. Examination type

Mid-term test (MTT) is an in class written task comprising 2 out of 3 open-ended questions to be answered in brief within 60 minutes. One full answer value is 5 credits (10 credits in total).

Final exam (E) is an in class written task comprising 4 out of 5 open-ended questions to be answered in brief within 120 minutes. Full answer value is 2,5 credits (10 credits in total).

9. Methods of instruction

The course combines lectures and seminars through a participatory sessions and group work. Lectures are designed to clarify major theoretical concepts and international experiences employed in regional STI policy studies. Seminars are aimed at sharing the students' reflections on the approaches introduced in the literature and developing analytical and practical abilities required to professionally discuss topics aroused during the course. The students are expected to be ready for discussions using the recommended readings and lecture materials.

10.HSE Library E-resources

OECD iLibrary. URL: https://www.oecd-ilibrary.org/

11.Software Support, including Open-Source Database Software

- Microsoft Windows 7 Professional RUS: internal university network (agreement)
- Microsoft Windows 10: internal university network (agreement)
- Microsoft Windows 8.1 Professional RUS: internal university network (agreement)
- Microsoft Office Professional Plus 2010: internal university network (agreement)

12. Special Equipment

Classrooms for lectures provide proper use and presentations of particular topics, specifically:

- PC with internet access and office software or laptop
- multimedia projector
- screen
- flipchart