

Discussing the Potential of Information and Communication Technologies' Innovation for Environmental Problems in Romania

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Abstract: This paper aims to identify the role and place of information and communication technology in Romania (ICT), the interest for innovation expressed in this field and the extent to which it relates to environment protection. The concern for the state of the ecosystem is growing, nevertheless it requires the active involvement in the innovation process so as to find solutions for the replacement of the old production techniques with new ones, environmentally friendly. ICTs in their spectacular evolution play a major role in this case. Frequently, they are present in all the production stages, from design to distribution of the final product. Starting from the above mentioned facts, the introduction of this paper presents the concept of green ICT and their implication in the economic and social development, as well as statistics data elaborated by international companies which are meant to increase their importance. In this section we include the objectives and prior work. We continued our research by presenting the way in which Romania gets involved in ICT innovation and environment technology, as green ICT stands at the junction between the two fields. The main conclusions and results are drawn in the end of the article. The value and implications of our research is in the area of green ICT innovation.

Keywords: green ICT; innovation; Romania; environment

JEL Classification: according O32; Q55; Q56

1. Introduction

The sustainable development is tightly linked to the technological innovation. In order to be in agreement with the environmental demands and the technological innovations, their implementation should be adapted to the specific characteristics of each country, in order to support its protection. Nevertheless, it is true that in the situation in which the possibilities to be informed and to communicate are increasing, some technological innovations are widely used without a prior analysis of the opportunities of their use or the impact on the environment. The introduction of new products, processes, business models and other organizational methods, and marketing techniques, whether through frontier or catch-up innovation, in principle contribute to the expansion of existing markets and the creation of new markets, in

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the process increasing the job content and poverty alleviation of growth. (Dutz & Sharma, 2012) For producers, the expansion of the market is very advantageous from the financial point of view and the motivation to use green products is mainly of moral and marketing content. As regards information and communication technologies (ICT), the contribution to the economic and social evolution is obvious. Even more, over the last 15 years, and mainly over the last ten years, ICT impacts on our society and economy have developed to the point of complete dependence. (Riaz et. al., 2009) A few of the drawbacks generated by ICT use are global warming, carbon emissions, great volume of e-waste, consumption of non-renewable resources and so on. On the other hand, ICT can seriously contribute to the improvement of the relationship with the environment: they can be environmentally friendly in themselves, due to their characteristics or their contribution to the decrease of the negative impact on the environment generated by other fields, considering their constant presence in the economic and social life. The growing popularity of the concepts of environmental technology (envirotech), green technology (greentech) or clean technology (cleantech) has led to the increased interest of different companies in technology improvement and less harmful production techniques for the ecosystem. Hence an important part is played by the pressure put by the communities who are more and more interested in the environment and the attitude of the international regulatory organizations. In this context, the companies in the ICT field have given a positive answer to these concerns by developing concepts such as green ICT, ecological informatics or ecoinformatics which integrate the concern for the environment in the spectacular evolution of the ICT field. The main concern so far has been the reduction of energy consumption with direct, immediate and easily highlighted financial advantages. Even more, the development of alternative, eco-friendly energy sources has facilitated the use of this component.

In Romania, the ICT field is representative for the economy as it concentrates on software development. A report published by SeeNews Company (2012) states that Romania is considered as the IT and outsourcing leader in central and SEE and one of the top 5 outsourcing destinations in the world and is first in Europe and sixth in the world in terms of number of IT certified specialists per capita, according to U.S. IT certifications provider Brainbench. As regards the perspective on the environment, there have been met so far many implementation problems. The European Union integration imposed that the European regulations should be in force, but their implementation and seeing the favourable results require a long period of time.

2. Problem Statement

The ICT innovation and long-lasting development are aspects which can be found in all European Union or other countries' plans. According to the results published by Thomson Reuters, in 2013 the most innovating fields are directly related to ICT or they are part of it. Figure 1 presents the ordering on different fields, highlighting the ones which are part of ICT or strongly related to it. We mention that two important countries, namely China and the UK are not included in the above mentioned study. According to the same source, the ranking for the most innovative countries is the following: the USA (45%), Japan (28%), France (12%), Switzerland (4%), Germany (3%), South Korea (3%), Sweden (2%), Netherlands (1%), Canada (1%), Taiwan (1%). (Thomson Reuters, 2013)

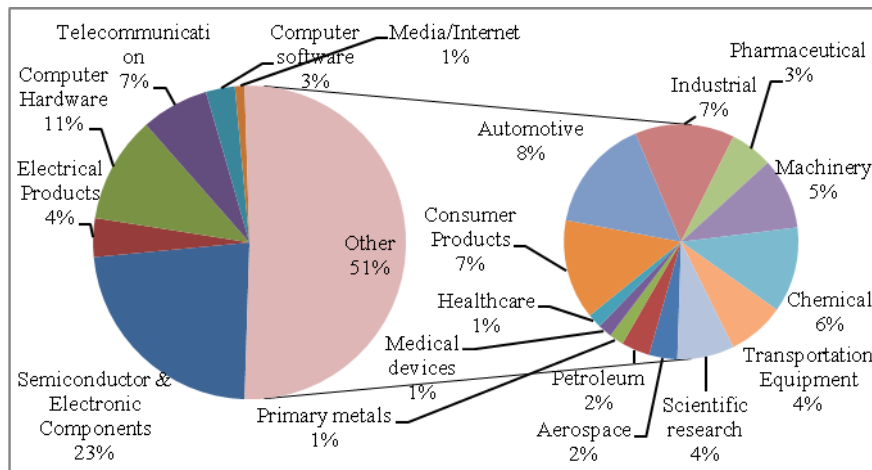


Figure 1. Industry Representation of Global Innovators

Source: Thomson Reuters, 2013

Another study, undertaken by Bloomberg Rankings, presents the hierarchy of the most innovative countries which includes the mentioned ones, but not in the same order. The decisive factors in the above mentioned study are: R&D intensity, productivity, high-tech density, researcher concentration, manufacturing capability, tertiary efficiency and patent activity. (Lu & Chan 2014) The ranking has the following structure for the first 10 positions: South Korea is considered to be the most innovative country, followed by Sweden, the USA, Japan, Germany, Denmark, Singapore, Switzerland, Finland and Taiwan. The rest of the countries mentioned in the ranking made by Thomson Reuters are positioned as follows: Canada number 11, France number 12 and Netherlands number 15. The final ranking includes 30 countries out of the 215 countries which had been analysed.

As regarding ICT, the USA, Japan and South Korea are definitely leading in all rankings; the European countries are less present. In any case, the ICT presence in Europe is greater than what it is presented by the World Economic Forum for 2014 according to which Finland once again tops the ranking of the most network-ready countries, followed by Singapore, Sweden, Netherlands, Norway, Switzerland, USA, Hong Kong, UK, Republic of Korea. (World Economic Forum & INSEAD, 2014) It is obvious that all the rankings include a certain degree of subjectivity and they cannot take into consideration all the factors which prove the involvement of the innovating countries. Depending on the considered factors, the results are different but they are dominated by the developed countries.

When it comes to green or ecological ICT innovation, the concerns and actions are rather well popularised and updated as the accomplishments in this field influence all the domains. A great number of companies with specific activities promote themselves by getting involved in environment protection actions, mainly by reducing the energy consumption or using renewable sources.

By means of green ICT or without being included in this category, ICT can support the long-lasting development related to the following opportunities (Murugesan, S., 2011, pp. 59-72):

- coordinating, reengineering and optimizing supply chain, manufacturing and other business activities to minimize their impact on the environment;
- making business operations, buildings and other energy-efficient systems;
- software tools for analysing, modelling, and simulating environmental impacts and for environmental risk management;
- platforms for eco-management, emission trading, and ethical investing;
- tools and systems for optimizing organizational workflows;
- tools for auditing and reporting energy consumption and savings and for monitoring greenhouse gas emissions;
- environmental knowledge management systems, meaning the acquisition and transfer of environmental knowledge, decisions support systems, and collaborative environments; environmental ontologies;
- environmental information systems engineering, including geographic information systems and environmental (meta-)data standards;
- urban environment planning tools systems;
- technologies and standards for interoperable environmental monitoring networks; smart in situ sensors networks;
- integration and optimization of existing environmental monitoring networks, easy plug-in new sensor cooperation, networks customization, and centralized and decentralized approaches.

Starting from the information presented above, we state the following issue for research: **how is Romania generally getting involved in innovation and particularly in green ICT?**

We state the following research hypothesis: innovation in green ICT is conditioned by the economic and social environment and in its turn, it conditions the economic and social evolution.

3. The Research Model

Our research methodology consists in describing facts by taking into consideration three variables from the research model: (1) the level of penetration of ICT, (2) innovation in ICT and (3) the use of ICT according to the environment regulations.

In Romania, the ICT field is one of the most dynamic (in comparison to others), with a significant contribution to the economic growth. Even if it is still very low ranked in EU, the statistics reflect a significant annual growth, but under the EU average. Thus, as regards the access to computers in private homes there has been registered an increase of over 24,4% since 2007 to 2013 and the daily use frequency has doubled since 2006 to the present. There has also been noted a significant growth since 2007 (Figure 2).

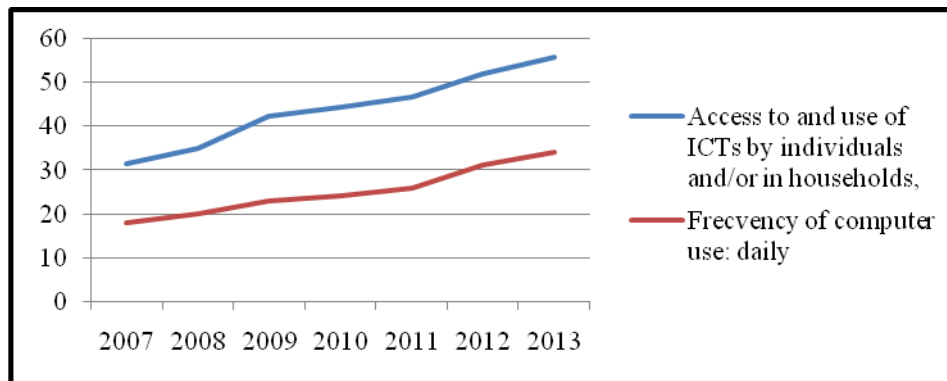


Figure 2. Access and use of computers and Internet by individuals between 2007 and 2013

Source: Eurostat, 2014

The Internet use has been noted as increasing in the number of users; still it remains way under the EU average (Figure 2). These data influence and are influenced in their turn by the living standards, the economic development, investment in research and development, the level of culture and education, so on. According to the studies made by the World Bank, there has been registered an 180

economic growth from the percentage point of view every 10% of connectivity increase and this relationship is even stronger in the countries with low and medium incomes. (Maclean, Akoh, 2010)

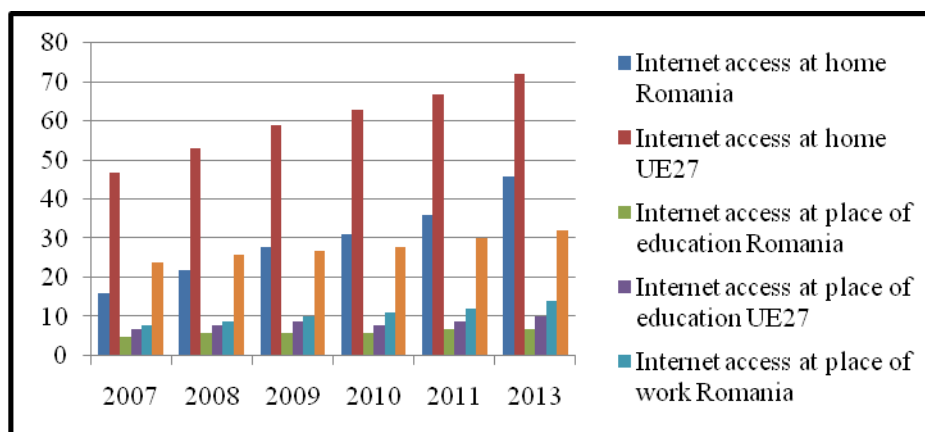


Figure 3. The use of Internet in Romania vs. EU during 2007-2013

Source: Eurostat, 2014

According to Eurostat, the percentage of people with computer skills had a favourable evolution during this period, surpassing even the EU average for the last years for basic skills and ranking under the average for the medium and advanced skills (Table 1).

Table 1. Number of people with computer skills (%)

Indicator	2007	2009	2011	2012
Individuals who have carried out 1 or 2 of the 6 computer related activities (%)				
Romania	14	17	15	14
UE27	13	14	14	16
Individuals who have carried out 3 or 4 of the 6 computer related activities (%)				
Romania	10	10	14	13
UE27	24	24	25	25
Individuals who have carried out 5 or 6 of the 6 computer related activities (%)				
Romania	5	9	10	8
UE27	23	25	27	26

Source: The Ministry of European Funds, 2013, Eurostat, 2014

The increase in the level of ICT penetration has a favourable impact on the economic and social development, but it also has a negative impact on the environment. These elements are deepened by the lack of a coherent legal frame on

the environment, the faulty enforcement of the existing one and the lack of severe auditing in the field. A study undertaken on 120 companies from different IT and non-IT domains revealed that only 20% out of those which have implemented environment policies take the out-of-use equipment to the recycling centres, 40% discharge them and the rest donate or sell them. The same study shows that only 34.5% of the companies support and apply environment policies. In Romania, the issue of recycling is known as critical for all categories of waste. A good example is the way in which the law on selective discharge is applied or rather not applied a law which has been in force since August 6th 2010. (MO, 2010) According to the information given by the Institute of Public Policy (IPP, 2011, pp. 16-21) only 33% of the public institutions included in the analysis provided the offices with the selective bins and 32% had special depositing rooms. Also, only 47% of the institutions created a plan to take measures for the selective discharge. When the big state institutions do not obey this law, the chance that the companies or the individual consumers obey a similar regulation is slightly probable and this makes it impossible for the EU to reach their aim to recycle at least 50% of the waste by the end of 2020. According to the same source which is based on the Ministry of Environment's statement from April 2011, only 1% of the total quantity of waste is put to value and Romania succeeds in reaching the target of 40% recycling only in the case of plastic.

The interest for environment and information technology is growing in Romania as well, even if it is much slower than in other EU countries and it is the same in case of innovation. A significant progress was recorded for the number of patents in ICT sub-fields. According to the statistics published by WIPO, there has been noted a significant growth during 2007-2012 in telecommunications, digital communication, computer technology, IT methods for management and environmental technology (Figure 4). As it can be seen, the most important growth was registered for environmental technology, which proves an increased interest in this field. Even if it does not stand for a direct component of ICT, we have presented in the chart as a consequence of the direct relationship with the topic of our paper.

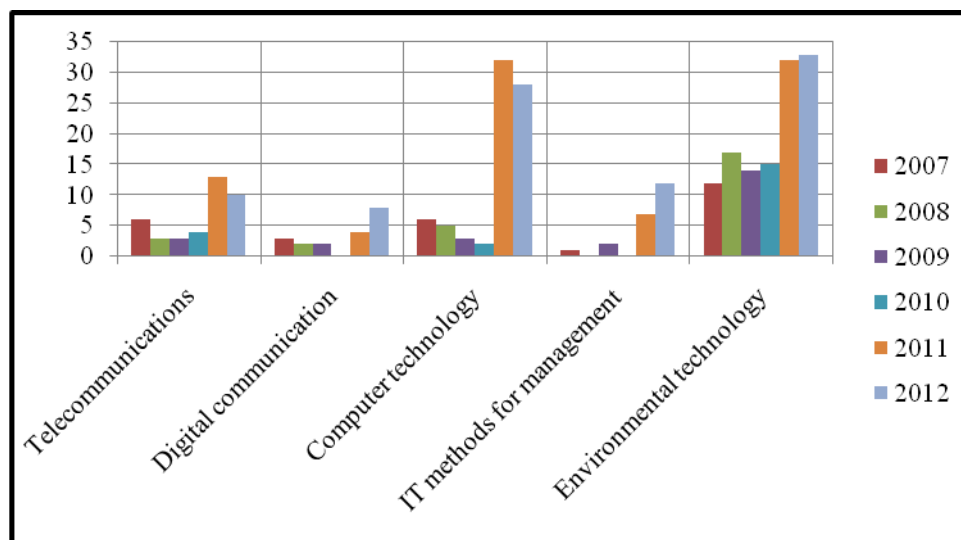


Figure 4. Evolution of the number of patents registered in Romania for ITC parts during 2007-2012

Source: WIPO, IP Statistics, 2013

According to the statistics published by the same organization, a comparison between the EU countries ranks Romania on position number 12 with a number of 133 registered patents during 2007-2012 in the field of environmental technology, at a significant difference from the top (Table 2), but on a higher position than other EU developed countries.

Table 2. Patents registered in Romania during 2007-2012 for ICT parts

No	Country	2007	2008	2009	2010	2011	2012	Total
1	Germany	944	917	1010	966	1067	1039	5943
2	France	401	432	463	442	448	381	2567
3	United Kingdom	233	244	238	222	198	112	1247
4	Poland	84	65	78	98	100	116	541
5	Spain	80	80	94	100	90	96	540
6	Sweden	57	64	40	98	107	99	465
7	Netherlands	82	65	65	90	67	87	456
8	Austria	49	55	44	45	47	39	279
9	Finland	43	34	37	17	41	32	204
10	Czech Republic	30	22	26	19	35	24	156

No	Country	2007	2008	2009	2010	2011	2012	Total
11	Denmark	19	38	25	16	15	22	135
12	Romania	12	17	14	15	32	33	123
13	Greece	24	17	23	14	13	17	108
14	Italy	17	30	19	15	9	6	96
15	Hungary	19	17	20	22	6	9	93
16	Ireland	13	6	7	15	13	6	60
17	Portugal	19	4	4	11	10	7	55
18	Slovakia	7	8	7	7	7	14	50
19	Croatia	6	7	9	5	8	8	43
20	Slovenia	5	9	4	5	7	12	42
21	Bulgaria	12	7	7	3	7	3	39
22	Belgium	8	2	2	1	4	2	19
23	Estonia		2	2	0	2	2	8
24	Luxembourg	1	1	1	1	1	0	5
25	Cyprus	1	0	0	1	0	0	2
26	Latvia	0	1	0	0	0	0	1

Source: WIPO, IP Statistics, 2013

The situation is approximately the same in the case of computer technology: Romania is on position 15 and Ireland, Italy and Hungary are lower. As it can be seen, the concern and actions favouring the environment and innovation are evolving. We consider that a favourable influence is held by the access to European funding in projects.

4. Results

Innovation in green ICT requires that the population, the companies and the state should get involved. It can also contribute to the economic and social growth and it has led to positive results in a big number of fields due to the fact that ICT is always present. According to a ranking made by OECD, the policies and programmes which manage the relationship with the environment can be split into three main categories: (1) those which are based on the decrease of the direct effects of ICT on the environment, (2) those which are concerned with the use of ICT applications in order to reduce the impact of society on the environment and

(3) those which combine the two categories of measures. (OECD, 2009, pp. 8-9) In Romania, there can be noticed the following facts:

- ICT has registered a continuous growth from the moment the country acceded to the European Union (our presentation has referred to this period), but it has remained on the last positions in several of its sub-fields;
- The interest in innovation, proven by the registered patents is also increasing both for the ICT sub-fields as well as for the environment technologies;
- The society is rather scarcely involved in the activities related to the environment, the companies do not have rigorous policies and the population might be called uninterested. The objectives related to the environment established by the state institutions have not been met as expected;
- Considering that the ICT field in Romania refers mainly to software, while the development of equipment is less represented, the initiatives in green ICT can be seen mainly from the perspective of the users and eventually from that of the creators of applications dedicated to the environment and its protection. We consider that the main role, with the greatest influences on the eco-system is played by the equipment producers.
- Accession of Romania to the European Union imposed the same laws regarding the environment and this will bring significant changes on medium and long term.

5. Conclusions

Romania does not have a clear legal frame and especially, regulations are not obeyed. This aspect is somehow encouraged by the lack of education as regards the importance of the environment, the low living standard and the political instability. Innovation is necessary in all fields, in the economic, private and public activities. The improvement in the ICT field, one of the most important in Romania will encourage displaying a changed attitude towards the environment. Also, the hardware and software products made by obeying the international regulations will determine all the countries to adopt the green ICT concept and practices, including Romania. All these are changes which will have effects noticeable on the long term and they require efforts from the whole society.

6. References

- Dutz, A. M. & Sharma, S. (2012). *Green Growth, Technology and Innovation*, Policy Research Working Paper, The World Bank, <https://openknowledge.worldbank.org/bitstream/handle/10986/3252/WPS5932.pdf?sequence=1>, date: 10.03.2014.
- Eurostat (2014). *Information Society Statistics*. http://epp.eurostat.ec.europa.eu/portal/page/portal/information_society/data/main_tables.
- International Energy Agency (2009). *Gadgets and Gigawatts: Policies for Energy Efficient Electronics*, <http://www.iea.org/textbase/nppdf/free/2009/gigawatts2009.pdf>, date: 2.08.2011.
- IPP (2011). *Diagnoză asupra implementării sistemului de colectare selectivă a deșeurilor la nivelul instituțiilor publice centrale din România/ Diagnosis on the implementation of selective waste collection system at the central institutions of Romania*, Bucharest: <http://www.ipp.ro/pagini/diagnoz259-asupra-implement259rii-.php>, date: 10.10.2013.
- Lu, W. & Chan, M. (2014). *30 Most Innovative Countries*. Bloomberg Rankings, <http://www.bloomberg.com/slideshow/2014-01-22/30-most-innovative-countries.html>, date: 18.05.2014.
- Maclean, D.; Akoh, B. & Egede-Nissen, B. (2010). ICTs, sustainability and the green economy. *Reconnect*, vol. 2, no. 3, pp. 161–165.
- Ministerul Fondurilor Europene/Ministry of European Funds (2013). *Rezultatele analizei documentare. Sectorul tehnologia informației și comunicațiilor/ Documentary analysis results. ICT Sector*, <http://www.fonduri-ue.ro/component/content/article/87-dezbateri-parteneriale/1293-rezultatele-analizei-documentare>.
- (2010). Legea 132/2010/Law no 132/2010, Published by Official Monitor no. 461/6 July.
- Murugesan, S. (2011). Strategies for Greening Enterprise IT: Creating Business Value and Contributing to Environmental Sustainability in USA Information Resources Management Association. *Green Technologies: Concepts, Methodologies, Tools and Applications* (3 Volumes), IGI Global; 1 edition, 2011, pp. 59-72.
- Necula, S. (2013). *Aplicarea cunoașterii în sistemele de fundamentare a deciziilor/ Application of background knowledge in decision systems*. Iasi: Sedcom.
- OECD (2009). *Towards Green TIC Strategies: Assessing Policies and Programmes on TIC and the Environment*. <http://www.oecd.org/internet/interneteconomy/42825130.pdf>, date: 17.03.2012.
- Welfens, Paul J. J. & Lutz, Christian (2012). Green ICT dynamics: key issues and findings for Germany, *Mineral Economics*, vol. 24, Issue 2-3, pp. 155-163.
- Păvăloaia, D. (2013). Methodology Approaches Regarding Classic versus Mobile Enterprise Application Development, *Informatică Economică/Economic Informatics*, vol. 17, issue 2, pp. 59-72.
- Popescu, D. (2012). *Knowledge Flows Percolation Model – a New Model for the Relation between Knowledge and Innovation*, Proceedings of the 18th International Business Information Management Association Conference (Innovation and Sustainable Economic Competitive Advantage: From Regional Development to World Economies), Istanbul, Turkey, pp. 445-453.

Riaz, M. T.; Gutierrez Lopez, J. M. & Pedersen, J. M. (2009). Strategies for the next generation green ICT infrastructure. I *Proceedings of ISABEL 2009: 2nd International Symposium on Applied Sciences in Biomedical and Communication*. IEEE. 10.1109/ISABEL.2009.5373604.

See News (2012). *Romania's IT Sector Grows Driven by Outsourcing*, http://research.seenews.com/wp-content/uploads/2012/11/IT_Market_in_Romania.pdf.

Sherringham, K. & Unhelkar, B. (2011). Strategic Business Trends in the Context of Green ICT in USA Information Resources Management Association, *Green Technologies: Concepts, Methodologies, Tools and Applications* (3 Volumes), IGI Global, 1 edition, pp. 1933-1952.

Thomson Reuters (2013). *2013 Top 100 global innovators. HONORING The World Leaders in Innovation*, date: 15.05.2014.

WIPO (2013). *IP Statistics*, <http://ipstatsdb.wipo.org/ipstatv2/ipstats/patentsSearch>.

World Economic Forum & INSEAD (2014). *The Global Information Technology Report 2014. Rewards and Risks of Big Data*, http://www3.weforum.org/docs/WEF_GlobalInformationTechnology_Report_2014.pdf, date: 20.05.2014.