GOVERNANCE OF *INDUSTRIE 4.0*. CONTRIBUTION TO THE DISCUSSION

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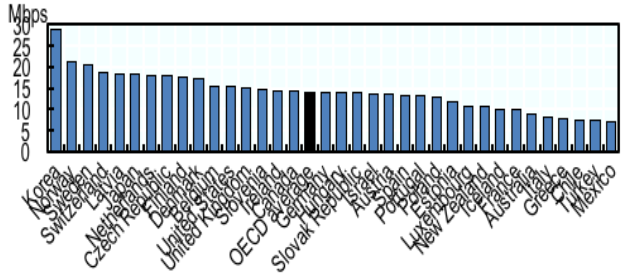
Abstract: *This paper is the endeavor to present the concept of Industrie 4.0 in terms of its governance prerequisites. On the one hand, there is a need to boost the innovation and productivity of the enterprises. On the other one, the technological changes are expected to respect not only economic, but also social and ecological security of citizens. The analysis drawn in the paper is based on the economic consequences of disruptive technological changes especially in their features concerning the need of governance in the light of the dilemma between the imperative of business effectiveness maximization and the necessity of social security.*

Keywords: ICT SECTOR, REGUATION 4.0, ICT INNOVATION-DRIVEN ECONOMY, SECURITY OF USER INTEREST

1. Introduction

An overwhelming pressure generated by the recent technological revolution in information and communication sector challenges the mode of behavior of every single individual, business and society across the world. The prior objective of a developing digital economy – aiming to growth and employment, is to provide access to high-speed broadband networks as well as to overhaul the law in that respect. The backbone of well prospering digital economy is efficient access as the conductor of effective use of information and communication infrastructure and services.

Figure 1. *Average Speed, 2016*[1]



The leading advertised download speed in the courtiers under analysis was 10 Gbps but it generally still remained a challenge for majority of countries as average speeds varied substantially across OECD countries.

Connectivity remains as one of the main building blocks (followed by effective use, skills, review of policies, security and privacy, strategic coordination) for a digital transformation supporting well-being. The growth in this area has been observed very clearly, but lagging especially in the access to fibre networks[2].

The tremendous pace of technology innovations (mobile devices and applications, social networking, cloud computing) needs to be accompanied by permanent assessment of the implications of these disruptive technologies[3]. The technologies that are characterized by the features representing the most disruptive technologies are mobile (communications, commerce, software and applications) and cloud (software as a service, infrastructure as a service, platform as a service). They are perceived as the drivers of the meaningful transition of consumer technologies, business models and industry ecosystems (new products, applications, services – mainly based on the Internet of Things, Big data analytics, Artificial Intelligence, Blockchains).

Converged broadband networks (NGN, Next Generation Networks) through the convergence of media, Internet and communications services generate new market players (therein new content and application providers - over-the-top) and new services (including the ones concerned with connectivity of things), as well as the change of consumer style of living, working, relaxing. These trends call for ubiquitous access to ICTs (Information and Communication Technologies) and put pressure on the adjustment of the rules of the game and business practices. Drastic increase of data flow caused by ease of access to information, development of new services and applications (cloud services, mobile applications) together with increasing complexity of the ICT markets challenge the traditional role of regulation and call for rethinking of the existing approach to regulation in a digital ecosystem.

The enormous necessity to leave the techno-economic decisions of economic agents free, on the one hand, and, the imperative to secure the balance between the interest of consumers and suppliers, on the other hand, generates the dilemma concerning the regulatory aspects of *Industrie 4.0*.

The main analytical problem faced herein is the effectiveness-driven versus security-driven facets of *Industrie 4.0*. The main objective of the paper is to spotlight on the governance of *Industrie 4.0* as an attempt to embrace the key elements of nowadays techno-economic revolution in ICT for the well-being of the societies around the world. The structure of the paper is imposed by the analytical frameworks based on the chief role of technology-driven determinants of regulatory transformation in the ICT and the followed economic adjustments, including the normative adaptation. Then, structure goes through the revealing of the notion of Regulation 4.0, and aims to the presentation of the dilemma between productivity and safeguarding as the proposed essence of the problem of the *Industrie 4.0* governance.

2. Economic character of technological transformation – the conceptualization of the problem

Upper level of industrialization characterized by the technology relying on self-service of users and highly standardized service offers calls for radical service innovation[4]. The 4th Industrial Revolution is described as the phase of techno-economic evolution directed toward integration of technology at physical, digital and biological areas. Therefore, there is a critical dilemma opening a wide area of discrepancy between pro-productive possibilities and a new range of impediments focusing mainly in consumers security and intellectual property rights.

The governance of *Industrie 4.0* appears as the efforts to advance the neutralization of the tension between the urgency toward economic efficiency and immanent requirement to make the human activities socially and ecologically secure. Herein, regulation is forced by the processes taking place in technology-driven economies, fields of human work and life. Digitalization and interconnection, data-driven innovation, and application and service convergence emerge as the possible areas to analyze the determinants of the regulation of economy in the 4th technological revolution.

Table 1: *Technology-native and economy-native determinants of next generation regulation of an economy*[5]

	Digitalization and interconnection	Data-driven innovation	Application and service convergence
Technology	cooperation of researchers and operators	importance of global, market-relevant technical standards	platforms potential to large scale, data acquiring and analyzing
	dispersion of infrastructure innovation	high-speed broadband connectivity	platforms potential to decentralization, complication of enforcing social protection (inc. working conditions)
	advancement of digital applications	Internet openness	threat of privacy deprivation
Economy	innovativeness of services	new business models	sufficiency of ICT skills of workers and citizens
	economic power of market players	digital inclusiveness of society (in respect to the development of new markets, new jobs)	proficiency of workers in problem solving and communications skills
	dynamics of market players adaptability	intellectual property protection	privacy risk and digital security in the network and the proficiency in managing them
			consumer trust
	dispersion of infrastructure investment		effects of scale, effects of scope, network externalities as the potential of market concentration and market entry blocking
			consumer patterns such as "sharing" and "on demand"

The nature of digital transformation of the economies worldwide is mainly operational, i.e. using and applying invented technologies within the interplay between technology and business. The potential of every single technology and business process is multiplied by the integrated techno-economic approach of deploying the sensors, social media, cloud, analytics, mobile, Artificial Intelligence and many more throughout the economy. These trigger the potential to economic cooperation across the industries and regions to create new partnerships oriented towards unifying experience to standardized offerings according to the responsiveness of customer's demand. All that requiring interoperability, the freedom of choice, as well as privacy and security and protection of consumer rights.

Adaptation of companies is additionally required in the face of growing transparency, consumer awareness and engagement, as well as new patterns of behavior such as "sharing" and "on demand".

Digitalization and interconnection, empowered by high computing power, together with "ecosystem of inter-related technologies" are listed as technological pillars of digital transformation[6]. In between, innovations that are data-driven accelerate the development of techno-economic ecosystem meant as the range of new products, applications and services (The Internet of Things, Big data analytics, Artificial Intelligence, Blockchain). Digitalization as the protection of data from degradation and as the means of communication by very high speeds at almost zero marginal cost[7] eliminates the physical constraints to information sharing and exploitation. Interconnection as the consequence of the growing importance of the Internet restores patency of its operations on the inter-company/operator and global scale. Data-driven innovation based on the movement of socio-economic activities to the Internet, the decline of the cost of data ("big data") operations aim to create the key assets in the economy, create new industries, processes, products to generate unique competitive advantage. Application and service convergence profoundly affects industries in their sale, development formula and market redefinition. The phenomenon is rooted in the design of the systems dealing with multiple technologies, set to meet entrepreneur and consumer utility expectations.

Digitalization, data-driven innovation as well as service and application convergence reformulate the functioning of many sectors and masses of employees. Digital innovations are mostly perceived as forming the basis to innovation networks, access to finance or the use and reuse of data, as well as the foundations of investment in ICT, knowledge-based capital or data analytics. New work patterns, the creation and disappearance of different sectors and jobs, reshaping trade agreements and labor law are the consequences[8].

3. Main prerequisites for exploring the potential of disruptive technologies - Regulation 4.0

The main drivers of communications markets expansion are demand empowered by technology innovations and adjusted regulatory frameworks (competition-, innovation- and investment-friendly) in particular jurisdictions.

The disruptive character of innovations rooted in recent technological advancements transmuting the trajectory of decision processes in every single factory and industry (Industrie 4.0) calls for the regulatory assistance in its role of the neutralizer of the divergence between efficiency impulses and security need and the engine of sustainable growth of well-being for all. The governance of *Industrie 4.0* emerges as the prerequisites of the exploiting the potential of the immense technological expansion.

The key means to diffuse innovation are **standards**. Therein are regulators featured by efficiency and effectiveness, ready with regulatory standards and good governance inevitable to administer and enforce regulations. Regulators are pivotal element of regulatory system to create pro-development regulatory regime addressing the wider objectives of sustainable growth and just society[9]. The regulatory role is mostly attributed to national regulatory agencies and International Telecommunications Union as ICT standardization global leader, intensively dealing with standardization gap between developed and developing countries, whose role is particular in case of scarce resources such as spectrum for mobile and wireless technologies or when Quality of Service is important.

Regulatory policy (licensing, standardization, managing the spectrum, interconnecting, providing universal access and service) is designed to **remove uncertainty and regulatory risk for service providers and their investors** by authorizing the provision of services, the operation of facilities or the use of radio spectrum (general authorization regimes). These determine the market structure and level of competition, and then the efficiency of supply of the ICT services to the public. But, as regulation is an art it is impossible to prescribe exhaustive policy for particular situations in the world of above-average dynamics, there are general objectives

and policy frameworks desirable as well as the mechanism of their consequent execution.

Currently, there is no concept of the regulatory approach that could result in the positive impact on the ICT sector and be accepted worldwide. First generation regulatory approach aimed to unravel the problem of monopoly which devoured the socio-economic potential of communication sector. Second generation of regulatory policy represented the proposals of liberalization and privatization. The regulation of third generation is concerned with preserving and managing the competition. Fourth generation regulatory endeavors to incorporate their own objectives in the frames of wider socio-economic policy goals[10], and are even more anchored in the specificity of a particular country than the previous generations of regulation.

The dynamics of innovation of digital technologies stands in stark contrast to the pace of regulation. There is a pressing need emerging in the digital world to react faster than classical instruments of regulation allow. This regulatory landscape represents a unique challenge for regulators to respond not too early (and stymie innovators) or not too late (and expose consumer to risks) and calls for regulatory decisions to be adequate, not to lose its relevance.

The concept of Regulation 4.0 characterizes regulatory approaches that promote innovative and apt solution for ensuring level-playing field for all market participants, stimulates the spill-over of services and access to services and applications without imposing excessive burden on operators and service providers (co-regulation, self-regulation, "smart" motivation etc.) for the well-being of all societies across the world.

The main drivers of Regulation 4.0 are technological transformation (services and networks convergence), and socio-economic transformation (consumer behaviours), as well as political objectives such as social inclusiveness and development. The perception can further be highlighted in the aspects of digitalization and interconnection, data-driven innovation, and application and service convergence (Table 1).

Regulation 4.0 is being designed to draw out the opportunities and challenges brought by digital transformation of economies and societies in the frameworks of whole-of-government approach policy[11]. And, the regulation's role is perceived as the critical in creating the incentives structures for business to consider the value to society.

4. Between productivity boosting and security safeguarding – the essence of dilemma

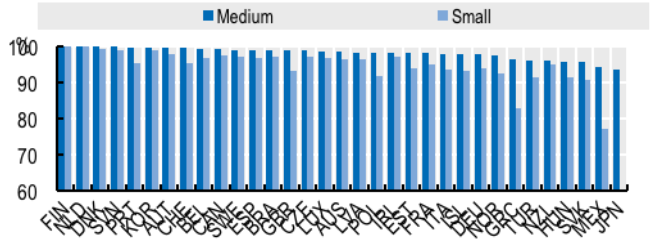
ICT plays a key role as a driver of innovation, as it accounts for the largest part the OECD businesses expenditure on research and development and over thirty percent of patent applications worldwide[12]. At the same time, users and consumers are exposed to the unprecedented risks often not even conceptualized.

Business benefits

Leverage from cloud technology for computer systems and storage, big data navigation, tagging, searching, visualization to help people manage with the mass of information more quickly. Information technologies function as the back office resources that result in driving the rest of the business world forward. The processes foster innovation in the unprecedented manner. Broadband enables the business processes to be more efficient and increase productivity. The new applications and services accelerate innovation. The clear-cut relationship between ICT and productivity is perceived through the rise of more complex production processes, as a result of economic growth, and the demand for labor force concerned with the flow of information for the purposes of production organization whose need for the ICT technology becomes more and more intense with the rising complexity of information processing. Information processing and provision of communication services attract employment through outsourcing[13].

There is considerable increase of enterprises getting connected to broadband networks, but out of them few make effective use of advanced ICT especially such as cloud computing and e-sales (lowest percentage of enterprises with ten or more employees in OECD respectively Poland and Mexico). Workers insufficiently use office productivity software (from nearly 15% of all users in Netherlands or Canada to less than 10% in such countries as Sweden, Japan, Finland)[14].

***Figure 3**. Small and medium enterprises with broadband access, fixed and mobile, 2016 (% of enterprises in each employment size class)[15]*



Digital gap is much less drastic, spreading from 100% of broadband access of medium and small enterprises in Finland, Netherlands to around 94% (medium) in Mexico and Japan and 77% (small) in Mexico. However, applying indicator of small and medium enterprises broadband access and as percentage of total businesses with ten or more employees the digital gap extends from 2,6% in Australia to 31,4% in Switzerland.

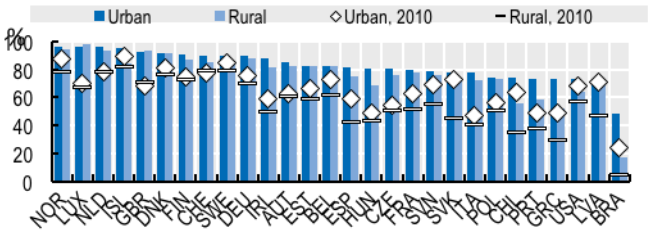
Social benefits

Consumer benefits come down mostly to easier access to personalized real-time information, increased personal productivity, ability to manage personal information online, improved connectivity with family and friends, greater convenience and more saving making through online purchases etc. Fundamentally new way of communication which is social media (Instagram, Twitter etc.) add great amount of dynamism to stay connected. The main barriers that arise are security and privacy governance and problems with customer adoption[16]. The threats emerging from security and privacy issues are balanced out by the benefits of adopting the new technologies. There are business models that are highlighted as the ones build on the necessity of transparency from technology vendors which is indicated as a key factor to build the customer trust and loyalty in the markets.

Positive impact of broadband access on consumer surplus (consumers' willingness to pay for the broadband services and actual prices) is the effect of efficient access to information, savings in transportation, gains in health care and entertainment.

And what is even more challenging and prosperous, the right to the broadband access has been approved as the fundamental citizen right[17].

***Figure 2**. Households with broadband connections, urban and rural, 2010 and 2016 (% of households in each category)[18]*



Broadband access in the households for Norway surging over 96% to Brazil reaching less than 50% in urban areas in 2017 depicts uneven chances in the societies worldwide to tap the potential of

broadband. The picture of the digital gap in the world amounting (according the above data) to almost second so much in the least connected households of the world in comparison to the most connected.

Security still remains a growing challenge with the digital security incidents experienced by individuals (aged 16-74) reported from nearly 30% of all individuals (Luxembourg, France, Hungary, Denmark) to less than 5% (Mexico, New Zealand)[19].

5. Conclusion

The opportunities and challenges arising in the transformation to cyber world call for permanent policy reviews and strategic coordination within national strategy governance to ensure the optimal participation of all enterprises, individuals and governments. Out of the them, fibre connectivity for all, effective use of digital technologies on every-day basis at work and at home, strengthened skills, adjusted legacy frameworks shape the next generation of regulatory approach as a whole-of-government strategy coordinated across countries. The prospective of *Industrie 4.0* are to be explored through the governance tuned toward fostering potential of digitalization while neutralizing social costs.

In the face of the immanent tendency to monopolize market power among market agents, the problem of security in the network, the development of intellectual property and intellectual capital, employee's promotion, patent award system (cash reward), acquisitions (IBM) form the foundation issues of regulatory platform to secure and stabilize these techno-economic trends of *Industrie 4.0*.

References

[1] OECD Digital Economy Outlook 2017, Chapter 3, Figure 3.29 Akamai's average speed, Q1 2016, s. 138.

[2] OCED Digital Economy 2017, OECD Publishing, Paris 2017.

[3] Disruptive technology aims to replacing exiting and established technology, that leads to the creation of the completely new industry, C. M. Christensen, The Innovator's Dilemma, 1997.

[4] Toni Janevski, "Internet Technologies for Fixed and Mobile Networks", Artech House, December 2015.

[5] OECD Digital Outlook … op. cit.

[6] OECD Digital …op. cit., s. 24.

[7] J. Rifkin, Zero marginal cost society, Palgrave Macmillan, New York 2014.

[8] OCED Digital … op. cit., s. 12.

[9] OECD Best Practice Principles for Regulatory Policy. The Governance of Regulators, OECD 2014, s. 49.

[10] A. Narayan, Trends in Telecommunication Regulation, ACMA ITU, International Training Program, Sydney 2014.

[11] OECD Digital … op. cit., s. 11.

[12] Ibidem.

[13] "Telecommunications Regulation Handbook", The International Bank for Reconstruction and Development / The World Bank, InfoDev, and The International Telecommunication Union (ITU), 2011

[14] OECD Digital …op. cit., s. 187.

[15] OECD Science, Technology and Industry Scoreboard 2017, chapter 6, graph 6.1.3

[16] Mobilizing Innovation: The changing landscape of disruptive technologies, KPMG Technology Innovation Survey 2012

[17] Report of the Special Rapporteur on the promotion and protection of the right to freedom of opinion and expression, Frank La Rue, Human Rights Council of the United Nations General Assembly 2011, A/HRC/17/27.

[18] OECD Science, Technology and Industry Scoreboard 2017, chapter 6, graph 6.1.2

[19] OECD Digital … op. cit., s. 260.