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Уредник

академик Марко АНЂЕЛКОВИЋ

Уређивачки одбор

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академик Дејан ПОПОВИЋ

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E d i t o r

Academician Marko ANĐELKOVIĆ

E d i t o r i a l B o a r d

Academician Ljubomir MAKSIMOVIĆ

Academician Vladimir STEVANOVIĆ

Academician Dejan POPOVIĆ

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Лектори за енглески језик
Татјана Ћосовић
Жарко Радованов

Технички уредник
Мира Зебић

Прелом
Никола Стевановић

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EDUCATION AS A WAY TO PREPARE SERBIA FOR A DIGITALLY CONNECTED WORLD

Marijana VIDAS-BUBANJA*

Abstract. – The digitalization level of society and economy is growing in accordance with the rising acceptance and implementation of digital technologies and the transfer of social and economic activities to the Internet. Serbia, being at the beginning of the information society and digital economy development, has to define a proper infrastructure-organization-human framework in order to tap all the advantages offered by new technologies for more competitive business operations of domestic enterprises and long-term sustainable development of the national economy. This paper analyses the role of education in the process of the digital transformation of the Serbian economy and society. It particularly points out to the importance of ICT education and digital innovations that create solutions and knowledge for economic development and progress in the modern digitally connected world.

Keywords: information and communication technologies, education, knowledge, development

INTRODUCTION

The emergence of information and communication technologies (ICT) as the key general purpose technologies in the last 40 years has affected almost every aspect of economic and social activities. The world has been experiencing positive effects from ICT on its economy, business growth, and living

* Belgrade Business School – High School for Applied Studies and Faculty for Finance, Banking and Auditing, Alfa University, Belgrade

standards. Both developed and developing countries are trying to properly implement information and communication technologies in order to use their innovation and growth potentials and opportunities in different sectors of the national economy.

For Serbia as a country in transition, faced with economic and financial instability and budget constraints, it is very challenging to overcome all the uncertainties and barriers for the role ICT can play in economic and business performance. Although in the past two decades in Serbia ICTs have generally improved their performance and the growth of the ICT sector has been reasonable, Serbia still needs to reform its economy in a way that allows ICT to become “the great enabler” it can be. The role of education for the proper ICT implementation in the Serbian economy and society is analyzed in this paper¹.

THE NEW DIGITAL BUSINESS ENVIRONMENT

The 19th and 20th centuries saw three industrial revolutions – mechanization, electrification, and automation. The 21st is seeing the fourth – digitization. The digital opens up unprecedented possibilities. Digital technologies and innovations are powerful, pervasive and have multiple, indirect impacts. These innovations are changing economies and markets, and reinventing relationships between organizations, suppliers and customers, thus becoming critical elements for growth, innovation and job creation².

The modern business environment changes under the influence of the second wave of disruptive digital technologies. According to the European Digital Transformation Scoreboard 2017, there are seven important digital technologies for doing successful business today and they are: mobile services, social media and cloud technologies, the Internet of things, cybersecurity solutions, robotic and automated machinery, big data and data analytics (Figure 1). The specificity of these digital innovations defined as The Fourth Industrial Revolution is that they bring about changes in the complete industry sectors thus becoming a key condition for further competitive business operations in the global market³.

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- 1 Vidas-Bubanja, M. and Bubanja, I., “The Future of digital economy in some SEE countries (case study: Croatia, Macedonia, Serbia, Bosna and Herzegovina)”, 39th *International Convention on information and communication technology, electronics and microelectronics MIPRO 2016*, May 30th–June 3rd 2016, Opatija, Croatia, Proceedings, 2016, 1780–1785.
 - 2 Deloitte, *Doing business in the digital age: the impact of new ICT developments in the global business landscape Europe’s vision and action plan to foster digital entrepreneurship*, April, 2013, 13.
 - 3 European Commission, *Digital Transformation Scoreboard 2017: Evidence of positive outcomes and current opportunities for EU business*, January, 2017, 7.



Fig. 1. Seven key technologies of the Fourth Industrial Revolution

Source: European Commission, *Digital Transformation Scoreboard 2017: Evidence of positive outcomes and current opportunities for EU business*, January, 2017, 9

The exponential speed of developments, disruption across all major industries, and the impact on entire systems of production, management, and governance are what differentiate these developments from previous “industrial revolutions”. The future holds an even higher potential for human development as the full effects of new technologies such as the Internet of Things, artificial intelligence, 3-D Printing, energy storage, and quantum computing unfold⁴.

According to McKinsey Global Institute, new digital technologies should be observed both in terms of their potential economic impact and the capacity to disrupt, because these effects go hand-in-hand and because both are of critical importance to leaders⁵. As the early 20th-century economist Joseph Schumpeter⁶ observed, the most significant advances in economies are often accompanied by a process of “creative destruction”, which shifts profit pools, rearranges industry structures, and replaces incumbent businesses. This process is often driven by technological innovation in the hands of entrepreneurs. For these reasons, the following characteristics of new digital technologies are positioned high on the importance level list⁷:

- 4 World Economic Forum, *The Global Information Technology Report 2016: Innovating in the digital economy*, Geneva, 2016, V.
- 5 McKinsey Global Institute, *Disruptive technologies: Advances that will transform life, business, and the global economy*, May, 2013, 1–2.
- 6 Schumpeter, Joseph A., *Capitalism, Socialism, and Democracy*. 3rd ed. 1942, Harper and Brothers, New York, 1950.
- 7 McKinsey Global Institute, *Disruptive technologies: Advances that will transform life, business, and the global economy*, May, 2013, 2–3.

- *The technology is rapidly advancing* and demonstrating a rapid rate of change in the capabilities of companies. Business processes experience breakthroughs that drive accelerated rates of change or discontinuous capability improvements.
- *The potential scope of the impact is broad as digital technologies* have broadly reached and touched companies and industries and are affecting (or giving rise to) a wide range of machines, products, or services.
- *Significant economic value could be affected.* An economically disruptive technology must have the potential to create massive economic impact. The value at stake must be large in terms of profit pools that might be disrupted, additions to GDP that might result, and capital investments that might be rendered obsolete.
- *Economic impact is potentially disruptive.* Technologies that matter have the potential to dramatically change the status quo. They can transform how people live and work, create new opportunities or shift surplus for businesses, and drive growth or change comparative advantage for nations.

ADVANTAGES OFFERED BY THE DIGITAL ECONOMY

From an economic point of view, ICTs boost productivity and reduce transaction and information costs, but their impact extends well beyond productivity gains. For example, for Europe it is estimated that one third (0.7 percent) of the average 2.2 percent GDP growth rate from 1995-2007 can be traced to ICT, of which more than half came from investment in ICT, one third from productivity gains in ICT production, and the remainder from productivity through ICT use⁸.

At the same time, ICTs allow new models of collaboration that increase workers' efficiency and flexibility⁹. Over a short period of time, digital technologies have moved from simply allowing businesses to do what they've always done, but more efficiently and effectively, to enabling businesses to completely change not only what they are doing, but also the business models they use to create value. In this way ICTs foster entrepreneurship and create new business models¹⁰.

8 European Commission, *Unlocking the ICT growth potential in Europe: Enabling people and businesses Using Scenarios to Build a New Narrative for the Role of ICT in Growth in Europe*, Brussels, 2013, 6.

9 European Commission, *Digital Transformation of European Industry and Enterprises, A Report of the Strategic Policy Forum on Digital Entrepreneurship*, Brussels, 2015.

10 Vidas-Bubanja, M. and Bubanja, I., „The Future of digital economy in some SEE countries (case study: Croatia, Macedonia, Serbia, Bosna and Herzegovina), *39th International Convention on information and communication technology, electronics and microelectronics MIPRO 2016*, May 30th–3rd June 2016, Opatija, Croatia, Proceedings, 2016, 1780–1785.

Digital technologies and innovations are powerful and have multiple impacts that create new challenges for business leaders and entrepreneurs. Companies in the digital economy support the idea of digital disruption in order to realize all potentials across a spectrum of digital opportunities. ‘Digital disruption’ refers to changes, both positive and threatening, and will affect companies in three ways¹¹:

- Customer insights combined with the ability to reach out to customers more effectively,
- Operating models - the way daily operations and processes are organized,
- Business models - the way value is created, delivered and captured.

In the new digital business environment of converging frontiers, traditional industry boundaries are becoming blurred and new competition rules are characterized by even closer cooperation between IT/ telecommunications firms and traditional manufacturing companies. In fact, IT firms are becoming the new industry leaders. The most recent examples: Facebook is acquiring a stake in the drones business and the Internet giant Google is entering the biotech sector and researching new methods of combating age-related diseases¹².

At the same time, the boundaries between industrial and non-industrial applications are also decreasing, changing the relations between industrial and service sectors. Although the focus of entrepreneurs is still on industrial working methods, they pay attention also on the reproducibility not only of identical products, but also of services. Services can be mass-produced too. High-quality digital (outsourced) services and a fail-safe, comprehensive digital infrastructure are becoming the fundamental prerequisites for the successful digitalization process¹³.

The digital economy changes the very nature of consumption, competition and how markets operate. It is also driving a significant shift in the balance of power between organizations and individuals owing to the explosion in connectivity and the availability of information. Online communications between customers and suppliers, social networks and interactive exchange of infor-

11 Deloitte, *Doing business in the digital age: the impact of new ICT developments in the global business landscape Europe’s vision and action plan to foster digital entrepreneurship*, April 2013, 9.

12 Ronald Berger Think Act, *Industry 4.0 The new industrial revolution, How Europe will succeed*, March, 2014, 12.

13 Vidas-Bubanja, M. and Bubanja, I., “Business Competitiveness of Digital Company”, *International Convention on Quality, USAQ 2017, JUSK, European organisation for quality, Faculty of mechanical engineering, Belgrade, 5–7 June, proceedings, 2017, 119–124.*

mation are putting today's consumers, employees, citizens, patients and other individuals in a controlling position¹⁴.

Enterprises must go further than just responding to and meeting customer needs. A higher-level of user-centricity is required that involves users in every business process, from gathering requirement, to product ideation and design, R&D, testing, production, marketing, to after-sales services. Only by leveraging users' collective wisdom can enterprises prosper, together with customers.

Though affecting every industry and business function, the impact and pace at which digitalization takes place differs across industries and businesses. The future of doing business in the digital age will mainly depend on the pace of digital development and adoption of new technologies, as well as on the outlook for the global and national business climate.

ICTs are vectors of not only economic but also of social transformation. ICTs offer significant social benefits, notably by enabling access to basic services, including financial services and education. Widespread ICT use by businesses, government, and the population at large is a precondition for all these benefits and opportunities to materialize.

WHY SERBIA NEEDS THE DIGITAL ECONOMY

Faced with stagnant or decreasing growth rates, rising unemployment and a worsening living standard of their citizens in the last decade, Serbia needs new digital sources of growth that will enable further reforms, modernization and innovation in order to boost growth rates and create jobs. As indicated in Table 1. ICT offers the solution for different economic challenges that Serbia has to deal with and an attempt will be made to comment on some of them.

- 1) *Serbia needs new sources of growth* - In order to overcome stagnant and decreasing economic growth, Serbia has to consider the possibilities offered by ICTs as they now play a catalytic role in economic and social life. The ICT sector—infrastructure and networks, IT-related services and media—is regarded as an engine of growth and a source of innovation, with some of the highest growth in productivity. The ICT sector also raises productivity throughout the economy by increasing efficiency across sectors owing to higher ICT use. ICT and Internet maturity correlate with wealth creation and will remain the biggest drivers of global economic growth

¹⁴ Deloitte, *Doing business in the digital age: the impact of new ICT developments in the global business landscape Europe's vision and action plan to foster digital entrepreneurship*, April 2013, 8.

Table 1. ICTs as a solution for economic challenges in Serbia

<i>ICTs as a part of the solution for a number of problems and challenges for Serbia</i>	<i>Serbia suffers from these key barriers:</i>	<i>Policy attention should be on:</i>
Serbia needs new sources of growth	Lack of policy attention	ICT should be a key priority for Serbia
A severe lack of productivity, lack of competition and growth	Businesses find it difficult to operate in the new ICT based manner, markets are closed and monopolized	ICT transformation of companies and liberalization of markets
Low level of innovation	Decreasing R&D activities, number of researchers, brain drain	Increase investment in education, research and development, especially in ICT
High unemployment levels	Jobs lost in the process of privatization, unemployment of the young	Active labor market policies, skills, life-long learning and education
Inefficient and expensive administration	Low productivity of public sector	Support e-government development
Transforming Serbia to a true knowledge economy	Lack of awareness about ICT potentials and risks	Create ICT supportive environment

Source: adapted by the author according to the European Policy Centre, *The Economic Impact of European Digital Single Market*, Final report, Copenhagen Economics, March 2010, 6.

- over the coming decades. Based on this, Serbia's growth model needs the following two elements: 1) central role of ICTs in the economy, that is, to enable productive and innovative use of ICTs across the whole economy and society, and 2) direct impact on economy and growth of the ICT sector itself¹⁵.
- 2) *Serbia is faced with a lack of productivity in domestic companies* – Empirical evidence shows that, on average, firms that use ICTs grow faster, invest more, and are more productive and profitable than those who do not. According to a World Bank study, sales growth and profitability are 3.4 and 5.1 percentage points higher, respectively, among firms that use ICTs effectively in their businesses¹⁶. In order to face decreasing production and export challenges caused by internal or external factors, Serbian companies

15 McKinsey Global Institute, *Internet matters: The Net's sweeping impact on growth, jobs and prosperity*, May, 2011, 9–28.

16 Ibidem.

can use ICTs to reduce business costs, improve internal management, and expand access to new technologies and information on market opportunities. ICTs can also help optimize supply chains, making it easier to get goods and services to the market.

- 3) *Serbia has a high unemployment level* -With growth prospects much more moderate than before the 2009 crisis and with social pressures high, it is urgent that the Serbian government adopts a more ambitious structural reform agenda for growth and jobs and use potentials offered by ICT in this area¹⁷. High unemployment underscores the need for the country not only to pursue pro-growth policies, but also to improve labor market flexibility and mobility through reforming, among others, the labor regulations to make their economies more contestable¹⁸. Most welcome in Serbia are initiatives that facilitate the development of sectors with the highest employment potential, including the low-carbon, resource-efficient economy (“green jobs”), health and social sectors (“white jobs”) and the digital economy. In fact, ICT-supported production and IT-based services have the potential to create jobs and advance the economic goals of Serbia. Direct and indirect employment opportunities, particularly for youth and women created this way are a chance for Serbia to reduce high unemployment rates¹⁹.

SERBIA IN THE DIGITALIZATION PROCESS

Progress to the digital economy in Serbia will be analyzed by using some key development indicators such as: a) individuals, households and enterprises using the internet, b) use of e-commerce, c) e-banking or e-government services, but also some complex ICT indexes, such as the network readiness index. The aim to follow the progress in the development of digital economy and society in Serbia in the framework of European digital agenda tasks was realized by collecting and comparing data between Serbia and the EU. This was possible because Serbia bases its statistics in the information society area on Eurostat methodology.

17 World Bank's Europe and Central Asia region's Poverty Reduction and Economic Management Department (ECA PREM), *South-east Europe regular Economic Report*, June 5, 2012, 51–57.

18 Ibidem.

19 Ibidem.

Table 2. Selected ICT indicators for individuals and households

	RS	EU28
<i>Internet use by individuals %</i>		
2010	40.9	71
2015	65.3	81
2016	67.1	84
2017	70.5	85
<i>Households with Internet access at home</i>		
2010	39.0	70
2015	63.8	83
2016	64.7	85
2017	68.0	87
<i>% of individuals using the Internet for interaction with public authorities</i>		
2010	-	41
2015	27.8	46
2016	28.1	48
2017	32.0	49
<i>% of individuals using e-banking services</i>		
2010	-	36
2015	12.9	46
2016	19.2	49
2017	22.8	51
<i>% of individuals using the Internet for ordering goods or services</i>		
2010.	6.1	40
2015.	22.7	53
2016.	26.3	55
2017.	28.3	57

Source: <http://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database>
 Serbia: for 2010-Statistical Office of the Republic of Serbia, *The Use of information-communication technologies in the Republic of Serbia 2011*, Belgrade, 2011, and for 2014–2017-Statistical Office of the Republic of Serbia, *The Use of information-communication technologies in the Republic of Serbia 2017*, Belgrade, 2017, 12–69.

In Serbia, Internet usage by individuals is close to 70%, but still below the EU average penetration of 85% in 2017. In EU28, 87% of households had Internet access in 2017. The number of households with Internet access in Serbia is rising and in 2017 it reached nearly 68% (Table 2).

The Digital Agenda sets the target that 50% of the population should buy online by 2015, with 20% buying cross-border²⁰. Serbia is significantly lagging in this respect (28.3% in 2017) and is still below the Agenda target and below the average value for EU 28 (57% in 2017). The use of e-banking services is also low (22.8% in 2017) compared to EU 28 (51%).

On the other hand, Serbia shows an increase of e Government usage when suitable services become available (32% in 2017) though the indicator is still below the target of 50% of EU citizens to use e Government by 2015, with more than a half of them returning filled-in forms²¹.

For enterprises, the use of ICTs influences the way that they are run, the way internal communications are organized, information shared with business partners, and customers communicated with (Table 3). Nearly all enterprises in Serbia with at least 10 persons employed had Internet access in 2017 (99.7%). Many enterprises in Serbia consider it important to be visible on the Internet and more than three quarters (80%) of enterprises had a website in 2017.

Despite having WEB sites, companies in Serbia are still modest in the use of the Internet for purchasing or selling online. Around a quarter of companies in Serbia receive orders online, and the percentage of companies having purchased online in 2017 was 41%²².

The proportion of EU-28 enterprises that used enterprise resource planning (ERP) software applications reached 36% in 2015 while a smaller proportion of enterprises (21%) used customer relationship management (CRM) applications²³. Enterprises in Serbia are very slow in accepting these practices in their work and are lagging behind the EU average in both aspects (ERP 16,2%, CRM 14,2% in 2014).

The World Economic Forum and INSEAD have been monitoring the global network readiness since 2002. The aim of the Network readiness index (NRI) is to measure the "...degree of preparedness of a nation or community to participate in and benefit from ICT developments".

20 European Commission, *A digital agenda for Europe*, com (2010) 245 final, Brussels, 2010.

21 Ibidem.

22 Statistical Office of the Republic of Serbia, *The Use of information-communication technologies in the Republic of Serbia 2017*, Belgrade, 2017, 12–69.

23 European Commission, *Digital agenda targets progress report, Digital agenda scoreboard 2015*, Brussels, 2015.

Table3. ICT use in enterprises

<i>Enterprises with Internet access</i>		
	RS	EU28
2010	96.8	94
2015	99.1	97
2016	99.8	97
2017	99.7	97
<i>Enterprises with WEB sites</i>		
2010	67.5	67
2015	75.2	75
2016	80.8	77
2017	80.4	77
<i>% of Enterprises using the Internet for interaction with public authorities</i>		
2010	70.6	-
2015	92.0	87
2016	98.6	88
2017	-	89
<i>% Enterprises receiving orders online (at least 1%)</i>		
2010	20.7	13 (Large enterprises 31%)
2015	22.9	17 (Large enterprises 38%)
2016	23.3	18 (Large enterprises 38%)
2017	23.8	18 (Large enterprises 39%)
<i>% Enterprises purchasing online (at least 1%)</i>		
2010	32.5	
2015	40.3	24 (Large enterprises 39%)
2016	41.0	24 (Large enterprises 38%)
2017	41.4	26 (Large enterprises 41%)
<i>% Enterprises using ERP</i>		
2014	16.2	31
2015	-	36

% Enterprises using CRM		
2014	14.9	30
2015	-	33
% Enterprises using cloud services		
2014	3.8	19
2015	9.2	-
2017	9.3	21

Source: <http://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database>
 Serbia: for 2010-Statistical Office of the Republic of Serbia, *The Use of information-communication technologies in the Republic of Serbia 2011*, Belgrade, 2011, and for 2014–2017-Statistical Office of the Republic of Serbia, *The Use of information-communication technologies in the Republic of Serbia 2017*, Belgrade, 2017, 12–69.

Networked Readiness Index is a composite indicator made up of four main categories (*sub-indexes*): 1) Environment sub-index (Political and regulatory environment, Business and innovation environment), 2) Readiness sub-index (Infrastructure indicators, Affordability, Skills), 3) Usage sub-index (Individual usage, Business usage, and Government usage), 4) Impact sub-index (Economic impacts, Social impacts). This represented one of the first attempts to make conceptual sense of the complex ICT reality, identifying the common factors that enable countries to use technology effectively²⁴.

Not unexpectedly, advanced economies are better than developing ones at leveraging ICTs. High-income economies dominate, taking the first 20 places in the overall NRI rankings in 2016. The performance of countries largely mirrors their position on the development ladder: a higher level of income is typically associated with a higher NRI score.

Europe is home to some of the best connected and most innovation-driven economies in the world. In particular, the Nordics—Finland (2nd), Sweden (3rd), Norway (4th), Denmark (11th), and Luxemburg (9th)—continue to perform well. Indeed, these five countries have featured in the top 20 of every NRI edition since 2012²⁵.

Since 2009 up to 2016 Serbia has been at the lower part of the NRI ranking list which proves that our country is more or less lagging behind in efforts and commitment to fully develop and leverage ICTs to boost its economic develop-

24 World Economic Forum and ISEAD, *The Global Information Technology Report 2016*, Innovating the digital economy, Geneva, 2016, 3–37.

25 Ibidem, 16.

Table 4. Network readiness index list for selected South East European countries (NRI)

NRI	Serbia	Montenegro	Croatia	BIH	Macedonia
2009/2010 (138)	94	42	51	110	73
2010/2011(138)	93	44	54	110	72
2012 (142)	85	46	45	84	66
2013 (144)	87	48	45	78	67
2014 (148)	80	52	46	68	57
2015 (143)	77	56	54	-	47
2016 (139)	75	51	54	97	46

Source: World Economic Forum and ISEAD, *The Global Information Technology Report*, different years (2009–2016), Geneva. In the brackets are numbers of covered countries for that year.

ment and competitiveness. Comparing Serbian position on the NRI list with some selected South East European (SEE) countries (Table 4) we can indicate that our position is improving, but that in the period 2102-2015 Serbia was the worst positioned among other neighboring countries of the SEE region. In 2016 the last on the list of the compared SEE countries was Bosnia and Herzegovina²⁶.

A very similar situation for the selected SEE countries can be seen on the Global competitiveness list with Serbia taking very low position among the analyzed group (Table 5). The poor position of SEE countries on NRI list is closely correlated with their bad performance indicated on the Global competitiveness list. This correlation indicates the high importance for the national economy to adopt digital technologies in order to enhance the productivity of its industries. Specific emphasis should be on countries' capacity to fully leverage information and communication technologies in daily activities and production processes for increased efficiency and for enabling innovation for competitiveness²⁷.

Despite this progress in the digital technology implementation, Serbia continues to suffer from low rates of e-business, weak political and regulatory framework and poor business and innovation environment. These factors affect their capacity to further leverage ICTs to boost their economies and benefit from higher rates of products and service innovation²⁸.

²⁶ Ibidem, 16.

²⁷ World Economic Forum, *The global competitiveness report 2016–2017*, Geneva, 2016, 5–10.

²⁸ Bilbao-Osorio, B. et al. „The network readiness index 2013: Benchmarking ICT uptake and support for growth and jobs in a hyper-connected world“, *The Global Information Technology Report 2013*, World Economic Forum, Geneva, 2013, 3–34.

Table 5. Global Competitiveness level of selected South East European countries (GCI)

GCI	Serbia	Montenegro	Croatia	BIH	Macedonia
2012	95	72	81	88	73
2013	101	67	75	87	67
2014/2015	94	67	77	-	63
2016 /2017	90	82	74	107	68

Source: World Economic Forum, *The Global Competitiveness Report*, different years (2012–2016/2017), Geneva.

The analyzed data indicates that, despite the fact that Serbia has created a good foundation for the digital economy development, our country is still positioned in the so-called „new digital divide“. This means that although ICTs are becoming increasingly affordable in our economy, the country does not have enough capabilities and capacity to:

- A) Use ICT potentials and improve the business quality of domestic enterprises,
- B) Realize the real impact of ICT implementation on the transformation of its economy and society.

The way out of the digital divide cannot be based only on investment in ICTs. While important, access is only one ingredient in the recipe for success. The effective use of ICTs and data requires additional investments in complementary knowledge-based capital (KBC)-in particular in (organization-specific) skills and know-how, and in organizational change including new business models and processes. Those with low or no formal education lack the necessary skills and know-how to take advantage of ICTs or to introduce the changes needed for ICT’s productive use in businesses and across society.

EDUCATION AND KNOWLEDGE CAN HELP SERBIA TO REACH THE DIGITAL WORLD

There is direct link between education and the digital transformation of the Serbian economy. The development of relevant talent and knowledge will determine whether we will take part in the opportunities of the Fourth Industrial Revolution or experience its disruptions as bystanders.

In the modern globalized world, education and training are the key drivers for growth and jobs and can help boost productivity, innovation and competitiveness of the national economy. In this respect according to EU standards upper secondary education is the minimum desirable educational attainment level for EU citizens. The importance of tertiary education is very high as it is: 1) linked with research and innovation, 2) provides highly skilled human capital, 3) creates national capacity to innovate and to adapt technology to the country's needs and to manage the risks of technological change. Lack of these levels of education presents a severe obstacle to economic growth and employment in an era of rapid technological progress, intense global competition and labor market demands for ever-increasing levels of skill²⁹.

According to the data from the Statistical office of the Republic of Serbia in 2014/15 school year, a total of 1.276.232 persons participated in any of the education levels, whereof preschool education comprised 15%, primary and lower secondary education comprised 45%, upper secondary 21.1% and tertiary 19%³⁰. Out of the total population of the Republic of Serbia aged over 15, 48.9% have completed secondary school, while one out of six inhabitants has attained tertiary education (Table 6). Tertiary education attainment among the population aged 30-34 was the among the lowest in Europe, amounting to 15 percent in comparison to around 30 in the EU15 Continental; and above 35 in the EU15 North.

Table 6. Different levels of education in Serbia, 2014/2015, total number

<i>Education level</i>	<i>Total number</i>
Primary level	555,573
Secondary education	257,646
Tertiary education	241,054
Second stage studies	41,411
Third stage studies	8,555

Source: Statistical Office of the Republic of Serbia, *Statistical Yearbook*, Belgrade, 2016, 96–108.

²⁹ Eurostat, *Smarter, greener more inclusive?, Indicators to support the Europe 2020 strategy*, Luxembourg, 2016, 110–111.

³⁰ Statistical Office of the Republic of Serbia, *Statistical Yearbook*, Belgrade, 2016, 91.

Globalization, digital technologies and new ways of working put a high premium on workers with skills and qualifications in science and technology. The dominant technologies of the digital world will be IT, electronics and robotics. But it will also embrace other knowledge areas such as biotech and nanotech. The technical competency profile will be interdisciplinary rather than specialized. Analytics specialists, engineers and programmers will have to be able to think across business models, production processes, machine technology and data-related procedures. Although the number of students in technical areas in Serbia is rising, in the 2012/13 school year they are still representing fewer than 20% of the Serbian student population, and only 15,5% out of the total number of graduates³¹. These are very low percentages having in mind that today's technological transformations increase the premium on technical skills and change the demand for different types of both enhanced social and technical skills.

For Serbian companies to perform the digital transformation process, it is important to require ICT knowledge for managers at all levels and to hire more ICT experts. Corporate cultures with continuous training and development in the workplace and lifelong learning are becoming a core competency. Significant changes are needed in this respect in domestic companies as, according to available data, domestic companies have as an average only 1.8% IT employees and invest 0,5-0,7% of their total income in IT³².

Education and training are becoming an integral part of every job. ICT skills are important for improving people's employability and labor market access. At the same time, a lot of collaborative and cross-cultural competencies will be required to be able to work in network environments sustainably. The following axioms in the field of human resources management in the 21st century are gaining importance³³: a) continuous education is essential and mandatory for employees and employers; b) information technology affects all jobs - no one is safe, nor can its impact be ignored; c) change is normative; d) work is highly interdependent in terms of business, in terms of communication and transport in different areas of activity; e) there is no standard way to climb the career ladder and progress.

In the digital world people need to have technical skills in order to be able to exploit the potentials of ICTs in everyday work and life. For the 90% of jobs nowadays basic informatics knowledge is necessary, but ICT is important for

31 Vojvodina ICT cluster, *ICT in Serbia at glance*, 2015, 47–51.

32 Ibidem, 30–31.

33 Lekić, S., Vidas-Bubanja, M. and Bogetić, S., "Educated and satisfied worker-foundation of modern and successful company", *Journal of Engineering Management and Competitiveness (JEMC)*, TF Mihajlo Pupin, Zrenjanin, 2014, vol. 4, no 1, pg. 27–33.

all in order to increase the quality of their everyday life. In Serbia in 2015, 34.2% of persons aged 15 and over are computer literate and 14.8% are partially computer literate, meaning that they know how to perform one of the basic computer activities (text processing, tabulation, sending/receiving e-mails and web browsing)³⁴. The Government needs to invest in the development of ICT skills for all and to engage in the rethinking of the education and training policies.

On the other hand, the implementation of ICT in the education system provides new possibilities for improving the quality of education at low cost. For this reason, Serbian government needs to support all the stakeholders - businesses, education providers and civil society institutions to identify the key education areas for focus and investment. It is important to focus on the quality of education in close partnership with the private sector and education institutions. Regional centers of excellence and distance learning can play a role³⁵.

Persistent brain drain of highly educated individuals poses an important challenge for Serbia, with negative effects on economic development. According to the Ministry for Religion and Diaspora, it is estimated that 3 to 4 million Serbs were living abroad as of 2010³⁶. The emigration rate of the highly-educated (i.e., those holding at least a first stage degree of tertiary education) was 12 percent in 2000, though it decreased to 7.2 percent in 2005/2006³⁷. This rate is, however; still higher than the corresponding average for non-OECD European and Central Asian economies (5.9 percent as a weighted regional average). According to MSTD data estimates, between 1991 and 2000, 30.000 graduates left the country³⁸. Most of them are professionals in information and communication technologies and natural sciences. Deep and negative effects of brain drain call for a systematic approach of the Serbian government to this problem and the creation of a national policy for the further prevention of brain drain, offering young educated people a chance for employment and good conditions for living.

34 Statistical Office of the Republic of Serbia, Statistical Yearbook, Belgrade, 2016, 91–114.

35 Vidas-Bubanja, M., "ICT Contribution to the Development of Some SEE Countries in Transition", *36th International Convention MIPRO 2013*, May 20–24, 2013, Opatija, Croatia, proceedings, 2013, 1513–1518.

36 World Bank Technical Assistance Project, *Western Balkans Regional R&D Strategy for Innovation*, Country Papers Series Serbia, October, 2013, 13.

37 OECD, *International Migration Outlook 2012*, Paris, 2012. Available at: http://www.oecd-ilibrary.org/social-issues-migration-health/international-migration-outlook-2012_migr_outlook-2012-en

38 Kutlača, D. 2010. Presentation by Djuro Kutlača at the "Circulation of Scientific Talent and Communication with Diasporas," *EREF Istanbul Workshop on Knowledge Transfer for Development*, May 12, 2010 Istanbul, Turkey.

The Serbian government should also create ICT innovation ecosystems across the economy by supporting policies that promote ICT innovation, developing local business incubation ecosystems, and promoting light innovation as a bottom-up and user-centric approach to drive ICT innovation across the economy³⁹.

Table 7. R&D in Serbia, total and in ICT

- In 2013 there were 14,643 researchers, which is about 8.0% of total employees
- The majority of R&D activities are funded by Government institutions (60%)
- The business enterprise sector contributes just 8% of the total R&D investment
- Only 6% of the total budget for science (€ 249 million) was allocated for both electronics and telecommunications and industrial software and informatics
- The private business sector in Serbia is only modestly involved in ICT R&D

Source: Vojvodina ICT cluster, *ICT in Serbia at glance*, 2015, 53–56.

The role of innovation in the Serbia, however, remains very limited. Observed as a percentage of GDP, gross domestic expenditure on research and development (GERD) in Serbia increased from 0.52% in 2003 to 0.73% in 2013. Low level of investment is particularly evident when R&D investments per capita are observed, which in 2013 amounted to only 71 in US \$ PPP, compared to 172 US \$ PPP in Croatia, or 742 US \$ PPP in Slovenia. The business sector accounts for only 8% of total R&D investments, so the largest burden of investment in research projects is financed by the state (public investment) (60%) and higher education (25%)⁴⁰.

This is also reflected in the exports of innovation products. Reflecting this limited role of innovation, SEE's medium and high-tech products and knowledge intensive services accounted for 17 percent of total goods exports in 2010, the lowest ratio in Europe. Consequently, Serbia receives marginal revenues from royalties and license fees from abroad (0.06 percent of GDP)⁴¹.

According to the UNESCO Report, the key structural challenges facing Serbia's national innovation system today are⁴²:

39 Vidas-Bubanja, M., "ICT Contribution to the Development of Some SEE Countries in Transition", 36th International Convention MIPRO 2013, May 20–24, 2013, Opatija, Croatia, proceedings, 2013, 1513–1518.

40 UNESCO, *UNESCO Science Report Towards 2030*, Paris, 2016, 290.

41 The World Bank, *South-east Europe regular Economic Report*, June 5, 2012.

42 UNESCO, *UNESCO Science Report Towards 2030*, Paris, 2016, 290–291.

- an absence of coordinated governance and funding;
- linear understanding on the part of the government of the innovation process, resulting in highly fragmented innovation system; this is the main obstacle to networking the R&D sector with the rest of the economy and society at large;
- persistent brain drain of highly educated individuals;
- an innovation system which is insufficiently attractive to private investment; the government needs to restructure the public R&D system and integrate the private sector into the national innovation system;
- lack of culture of technological entrepreneurship in universities and the government sector;
- the absence of evaluation culture; and
- system which favors the supply side of R&D over the demand side.

Our analysis highlights that education and innovation have one of the key roles in the further digitalization process of the Serbian economy and society. Serbia needs to adopt harmonious and comprehensive strategies that do not focus only on improving access to ICTs but also on creating the ecosystem for spurring education, long-life learning, training and strengthening the conditions that enhance innovation. These factors are also crucial to boost competitiveness and well-being, to enhance economic growth, and to create jobs in the Serbian economy.

CONCLUSION

Digital technologies are one of the most important sources of growth for national economies. They enable economies to create more jobs, improve people's lives and build better and greener societies. However, the analysis performed in Serbia proved that despite progress in the last decade in the creation of basic preconditions for the digital economy, the huge potentials of ICT still remain untapped. There are three conclusions that can be selected from the above analyses, as follows:

- 1) Serbia is still at the beginning of the digitalization process in its economy and society as the speed with which we have applied and used these technologies was not high enough. OUR competitors do it much faster!
- 2) Serbia has the foundations for digital economy development but the infrastructure, organization and human resource frameworks have to be fur-

ther improved in order to enable domestic enterprises to do their business more competitively through the ICT use, and the national economy to realize long-term dynamic economic growth;

- 3) General education and especially ICT education are important factors in the digital transformation of the Serbian economy and society. For Serbia it is important to enable: a) digital competences for all, b) stimulate education and ICT education, c) stop the brain drain and keep the talents and educated young people at home, d) stimulate and invest more in research and development.

Closing the digital divide is a pressing concern for the Serbian government and it is a significant opportunity for growth in today's digital economy that should not be neglected. There is a need to stimulate a more innovative and entrepreneurial mindset and accelerate smarter use of 'digital' technology in various sectors of the economy in Serbia. Education and innovation hold high importance in this respect.

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ОБРАЗОВАЊЕ КАО ПУТ ЗА ПРИПРЕМУ СРБИЈЕ ЗА ДИГИТАЛНО ПОВЕЗАНИ СВЕТ

Маријана ВИДАС-БУБАЊА

Резиме

Појава информационо-комуникационих технологија (ИКТ) као кључних технологија опште намене које подржавају различите пословне активности утицала је у последњих 40 година на скоро све области рада и деловања. Савремени свет данас реализује бројне позитивне утицаје ових технологија на економију, раст пословања и унапређење животног стандарда. Управо зато и развијене земље и оне у развоју настоје да на прави начин примене ИКТ како би искористиле све иновативне потенцијале и динамику раста које ове технологије доносе привреди у укупном друштву.

За Србију као земљу у транзицији суочену са економском и финансијском нестабилношћу и буџетским ограничењима прави је изазов савладати све неизвесности и баријере које стоје на путу примене ИКТ тако да оне постану основни покретач економских активности. У последње две деценије Србија је значајно унапредила приступ ИКТ-у, остварила развој ИКТ тржишта и самог ИКТ сектора, али остају неопходне даље реформе у домаћој економији које би омогућиле да дигиталне технологије постану кључни носилац економског и друштвеног раста и развоја.

Српска предузећа више или мање заостају у потпуној примени ИКТ у свом раду и пословању, тако да спор ниво дигиталне трансформације прави одраз налази у ниском нивоу конкурентности домаћих предузећа. У Србији се и даље остварује релативно низак ниво е-пословних трансакција, недовољно је развијен менаџерски и правни оквир примене дигиталних технологија у пословању, а заостатак се евидентира и у нивоу остварених иновација производа, услуга и пословних процеса. Ови фактори ограничавају капацитет националне економије да на прави начин искористи предности дигиталних технологија у смислу динамизирања економије и остваривања конкурентније позиције на глобалном тржишту.

Управо зато, један од приоритетних задатака српске владе је убрзање процеса дигитализације домаће привреде с обзиром на то да се ту препознаје значајан потенцијал бржег развоја, и с обзиром на чињеницу да развој информационог друштва и дигиталне економије представља и један од приступних услова Србије за пуноправно чланство у Европској унији.

Србија мора даље развијати и тзв. чврсту (хард- широкопојасне конекције, хардевски потенцијали) и меку инфраструктуру (софт- едукација, знање, иновације) како би била способна да се суочи са изазовима нове Четврте индустријске револуције и да одговори на нови талас дигиталних технологија везаних за мобилне комуникације, друштвене медије, облак рачунарство, биг дата аналитику, паметне уређаје, Интернет ствари.

Добро развијена телекомуникациона инфраструктура великих брзина и високе пропусне моћи која би била расположива у свим секторима домаће привреде може бити искоришћена само од стране образоване радне снаге која ће поседовати одговарајућа техничка знања и бити ИКТ писмена. Знање представља кључни део тзв. меке инфраструктуре која је неопходна за реализацију трансформације привреде у дигиталну привреду, а укупног друштва у информационо друштво. У Србији су неопходне активности на укупном подизању свести о савременој дигиталној реалности која захтева базну ИКТ едукацију за све грађане и укључивање ИКТ образовних садржаја у све области обука и учења. Поред образовања, иновациона способност привреде мора бити подигнута на виши ниво како би се проширили потенцијали домаћих предузећа да на прави начин усвоје и реализују нове дигиталне технологије. Поред државе значајно се више мора укључити и пословни сектор у ИКТ образовање и иновације. Значајан одлив младе образоване радне снаге, посебно инжењерских специјалности, представља посебан проблем коме домаћа влада мора дати приоритетни третман и развити одговарајуће програме за мотивисање и задржавање младе образоване радне снаге да остане у земљи и својим знањем допринесе развоју домаће привреде. Нови реформисани образовни систем који ће ИКТ вештине препознати и позиционирати на прави начин и динамичан иновациони систем су кључни предуслови за припрему Србије за нови дигитално повезани свет.

Кључне речи: информационо-комуникационе технологије, образовање, иновације, знање, развој