Lazar Živković
University of Belgrade
Institute Mihajlo Pupin

Đuro Kutlača
University of Belgrade
Institute Mihajlo Pupin

Alexander Kleibrink
European Commission
Joint Research Centre (JRC)

Dijana Štrbac
University of Belgrade
Institute Mihajlo Pupin

CHARACTERISTICS OF THE SOFTWARE INDUSTRY IN SERBIA* **

Karakteristike IT softverske industrije u Srbiji

Abstract

The objective of this paper is to identify the main characteristics of the software industry in Serbia, its strengths and challenges, as well as trends that are likely to influence this sector in the future. The study presents results of a survey of the software sector in Serbia conducted by the Institute Mihajlo Pupin from November 2017 to January 2018. Despite the huge regional disparities in the distribution of turnover between regions in Serbia, the software industry has been the most dynamic and fastest growing sector in Serbia in the last decade. There are many challenges regarding legal and financial framework conditions, taxation, legislation and online payment that need to be addressed by the Government of Serbia in order to create a friendly environment for this sector. The potential of the software industry is recognized and substantial support (both political and financial) from the Government is expected in the upcoming period. Respondents forecast further growth of the software industry and high demand for highly qualified staff.

Keywords: *software industry, SWOT analysis, future trends, Serbia*

Sažetak

Cilj rada je identifikacija glavnih karakteristika IT softverske industrije u Srbiji, njenih prednosti, izazova i trendova koji će u budućnosti uticati na ovaj sektor. U radu su prikazani rezultati istraživanja o IT sektoru koje je Institut Mihajlo Pupin sproveo u periodu od novembra 2017. do januara 2018. godine. Iako postoje velike regionalne razlike u ukupnom prometu između regiona, IT softverska industrija je u poslednjih deset godina najdinamičniji i sektor koji se najbrže razvija u Srbiji. Postoje brojni izazovi u domenu poboljšanja pravnih i finansijskih okvira, poreza, zakona i on-line plaćanja koje Vlada Srbije treba da reši kako bi se stvorilo podsticajno okruženje za ovaj sektor. Potencijal ovog sektora je prepoznat i u narednom periodu se očekuje značajna podrška (politička i finansijska) od Vlade Srbije. Predviđanja ispitanika za naredni period jesu rastući trend sektora softverske industrije i velika potražnja za visoko kvalifikovanim zaposlenima.

Ključne reči: *IT softverska industrija, SWOT analiza, budući trendovi, Srbija*

Introduction

Information and communication technology (ICT) is seen as providing essential infrastructures and tools for knowledge creation, sharing and diffusion, increasing the innovation capacity of other sectors and contributing to overall productivity growth [4]. This importance of ICT is reflected in R&D budgets worldwide, where it typically makes up for approximately 25% of the total R&D investment [3]. More generally, there is a growing perception that ICT strongly determines the way economies and societies keep up with, and possibly benefit from, the globalization process [2]. Research has shown that benefits from investments in ICT do not differ between developing, emerging and developed countries [7].

In recent years, the ICT sector in Serbia has become the most attractive sector of the economy. Rapid development and promotion of IT services, especially in the field of Internet and mobile technologies, application development and outsourcing, is evident. In the global market, IT companies from Serbia are mostly engaged in outsourcing, software testing and website design, as well as in the embedded systems. The largest markets for Serbian outsourcing industry are Germany, USA, the United Kingdom and the Netherlands. Serbian IT companies that are successful in outsourcing activities have recently developed their own products with high export potential. As the global IT market continues to evolve, the needs for outsourcing jobs are rising. Serbia is geographically well-positioned to provide financially viable and reliable alternatives to the already developed markets. Some of the key advantages of Serbia with regard to cooperation with foreign companies are an exceptional source of well-educated staff, attractive labor costs, excellent working skills, good communication and foreign language skills. This has not always been the case, given that Serbia has faced a massive brain drain of ICT graduates and professionals for years [6]. Considering today's growing demand for ICT products and services, which is a general trend not only in Serbia but throughout Europe [1], Serbian educational institutions face the challenge of attracting an even higher number of students and offering more experts to the market.

ICT production takes place in many industries, either as a principal or secondary output. It is therefore not possible to use industry statistics to obtain a complete measure of ICT production. Nevertheless, the identification of industries whose principal products are ICT goods or services was thought to be an essential component for a statistical framework to measure developments in the information society [9]. The OECD defines the ICT sector as a combination of manufacturing and service industries, whose products electronically capture, transmit, or display data and information [8]. According to this definition, the ICT sector is divided into two sub-sectors: telecommunications and information technologies (IT). Furthermore, the IT sub-sector comprises three segments: hardware, software and services. In this research, we focus on the software sector.

The paper presents some of the first results of an ICT case study in Serbia carried out by the Institute Mihajlo Pupin with the support of the European Commission's Joint Research Centre (JRC) in the period from November 2017 to January 2018. This case study evaluates the current state of the software industry in Serbia for the purpose of developing a new Research and Innovation Strategy for Smart Specialization (RIS3) in Serbia. The paper is organized in the following way. First, we provide an overview of the software market in Serbia. Then we present the research design and the main results, which are divided into three segments: profile of IT software companies in Serbia; SWOT analysis; and future trends in IT software industry in Serbia. We conclude with an outlook on what the implications of our findings are for the new innovation strategy in Serbia.

Market analysis of the software industry in Serbia

We take into account the following groups of NACE Rev. 2 classification of economic activities as part of the software industry: 58.2 Software publishing; 62.0 Computer programming, consultancy and related activities; 63.1 Data processing, hosting and related activities; web portals, and 63.9 Other information service activities. The software sector will be analyzed on the basis of its turnover, employment and salaries, export and import.

The total turnover of the software sector in Serbia in the 2010-2015 period exhibited an upward trend. In the 6-year period, the total turnover has more than doubled, i.e. it increased from RSD 34.6 billion in 2010 to RSD 75.5 billion in 2015. The Serbian software sector was employing 19,152 workers in 2015, which is a modest number in comparison to 2.57 million of employees in the country. According to data from the Labor Force Survey (LFS), the number of employees in the software sector declined in 2011 and 2012, but in 2013 it began to rise. In general, it almost doubled in the 2010-2015 period (Table 1). These trends confirm the emerging nature of the software sector in Serbia.

The majority of the activities in this sector was related to computer programming, consultancy and related activities. The share of this activity was approximately 90% throughout the entire observed period, and it has increased by almost 4% in 2015 compared to 2010. Services in the field of data processing, hosting and related activities and web portals also constitute an important part of the software sector, although they showed a downward trend in the respective period. The share of this group of activities declined by around 4% in 2015 in comparison with 2010. Software publishing and other information service activities make up for a less significant (less than 1%) share of the turnover in the Serbian software sector [5].

The highest number of employees is recorded for computer programming, consultancy and related activities. In 2015, the number of employees in this group took up as much as 67.84% of total employment in the software sector.

Compound annual growth rate (CAGR) calculated for the 6-year period per sub-groups of the software sector shows that the highest growth rate of employees was recorded in computer programming, consultancy and related activities (14.2%) and in software publishing (10.5%).

There are huge regional disparities in the distribution of software sector turnover between the North and South of Serbia. Turnover of the software sector in the North of Serbia (covering the regions of Vojvodina and Belgrade) was approximately 20 times higher than in the South of Serbia (Šumadija and Western Serbia, Southern and Eastern Serbia) in the observed time period. The regional distribution of the turnover in the software sector across the four regions in Serbia is presented in more detail in Table 2. In the Belgrade region, the turnover recorded an absolute growth in the 6-year period and an average share of around 80%. The turnover of the software sector in Vojvodina experienced both an absolute and relative increase: it recorded a growth of RSD 7.4 million and 3.1%. The turnover of this sector in the region of Šumadija and Western Serbia and in the region of Southern and Eastern Serbia slightly increased in absolute terms, but in its relative share it was almost constant: 2% and 3% respectively.

The highest number of employees has been recorded in the Belgrade region throughout the entire period, except in 2012. It is interesting to note that in 2012 Vojvodina had a slightly higher number of employees in the software sector than Belgrade, but the turnover of the sector was higher in Belgrade by around RSD 31.8 billion. Šumadija and Western Serbia and Southern and Eastern Serbia have

Table 1: Turnover and employment in the software sector in Serbia

	2010	2011	2012	2013	2014	2015
Turnover of the software sector in Serbia (in RSD)	34,614.994	39,110.659	46,196.095	54,765.593	61,647.037	75,468.254
Total number of employees	10,464	8,873	7,009	10,072	17,160	19,152

Source: Statistical Office of the Republic of Serbia.

Table 2: Regional distribution of turnover of the software sector across the four regions in Serbia

	2010		2011		2012		2013		2014		2015	
	RSD mill.	%	RSD mill.	%	RSD mill.	%	RSD mill.	%	RSD mill.	%	RSD mill.	%
Belgrade	28,556	82.5	32,232	82.4	37,736	81.7	44,891	82.0	10,114	81.3	59,828	79.3
Vojvodina	4,313	12.5	4,868	12.4	5,949	12.9	7,059	12.9	8,491	13.8	11,753	15.6
Šumadija and Western Serbia	659	1.9	815	2.1	906	2.0	1,006	1.8	1,112	1.8	1,597	2.1
Southern and Eastern Serbia	1,088	3.1	1,196	3.1	1,605	3.5	1,810	3.3	1,930	3.1	2,290	3.0

Source: Calculated by the authors on the basis of data from the Statistical Office of the Republic of Serbia.

a substantially lower number of employees. However, in the last two years of the observed period, a significant increase of employment in Southern and Eastern Serbia took place (Figure 1).

In 2015, the highest share in total gross earnings in the software industry was observed in computer programming, consultancy and related activities (58%) and data processing, hosting and related activities, web portals (19%) [8].

Due to lack of trade data, the trade balance will be presented only for software publishing. This data shows an unfavorable position of Serbia in international trade: virtually in the entire 2012-2016 period, the trade balance was negative (Table 3). Therefore, Serbia was importing more software than it exported, which had a negative effect on the country's balance of payments. However, this incomplete picture does not take full account of the fact that most software activities in Serbia are geared toward international markets.

The negative balance of software publishing in international trade was characteristic of all the regions in the 2012-2016 period, except for the Belgrade region in 2012 and 2013.

In order to determine the top exporting countries for Serbian software publishing, we first identified the top

ten export destinations. In the second step, we selected four countries with the highest value of export for each year. These top exporting countries are Austria, the United Kingdom, Bosnia and Herzegovina and Montenegro.

Research design

We conducted an online survey distributed to software companies in Serbia. The general aim was to identify the main strengths and challenges of the software sector in Serbia, its main sub-specializations, the compositions of the national value chain/network, future development trends and level of internationalization and possible directions of innovative development. Our results provide useful insights for policymakers in Serbia for evaluating the current state of the software industry in the country, planning future activities and stakeholder dialogues and the development of RIS3.

The survey was conducted from November 7th to December 25th 2017. It consisted of 45 questions and included seven main parts: General characteristics of the company, Growth and competitive advantage of the company, Strategic partnerships and cooperation, Placement and market, Research-Development-Innovation in the company, Strategic development directions, and Distinguishing characteristics of the company.

We delivered the questionnaire to the respondents by email (with a link to the questionnaire in LimeSurvey). An invitation to complete the questionnaire was sent to 1,089 companies, out of which 195 companies responded to it, which means an 18% response rate. After screening the data for high-quality replies, the total number of companies whose responses were analyzed was 56. This made for one third of the responding companies (28.72%).

Table 3: Export and import of software publishing in Serbia (in EUR)

Year	Export	Import	Trade balance (+, -)
2012	1,263,415	1,977,242	-713,827
2013	1,192,312	1,160,958	+ 31,354
2014	438,446	1,450,204	-1,011,758
2015	714,618	2,020,430	-1,305,812
2016	398,234	842,129	-443,895

Source: Calculated by the authors on the basis of data from the Statistical Office of the Republic of Serbia.

Figure 1: Regional distribution of employees in Serbia's software sector
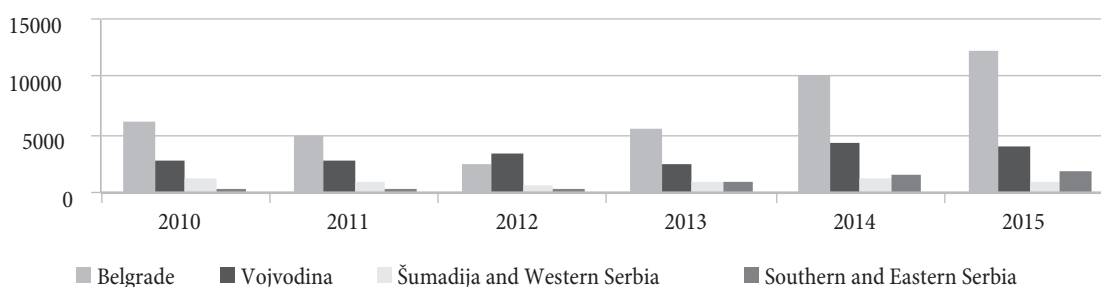
Source: Statistical Office of the Republic of Serbia.

This paper presents the results of the survey, with the main focus being on the profile of software companies in Serbia, the main strengths and weaknesses of this sector, as well as on future trends.

Empirical results

Profile of IT software companies in Serbia

When it comes to geographical distribution of software companies in Serbia, companies are mainly located in Belgrade, Niš and Novi Sad. In the vast majority of other municipalities there is an insignificant concentration of software companies. Nearly 50% of the companies from the sample are located in the Belgrade region, which is the most developed region in the country. More than one third of the companies are operating in the Vojvodina region, while 20% are from Šumadija and Western Serbia and Southern and Eastern Serbia. Almost half of the sample is covered by the companies that are operating in the market for more than ten years. Around 7% of the sample includes young companies that are 1-3 years old. More than 65% of companies have up to ten employees (Table 4). The scope of their activities includes computer programming, consultancy and related activities (over 60%), data processing, hosting and related activities, web portals, software publishing and other information service activities.

The total number of employees in the software sector in Serbia in the 2013-2017 period shows an upward trend which is in line with official LFS data. In the 5-year period, employment increased by 57%. Around 84% of employees hold a university degree and more than 80% of them are working on software development.

The increasing trend of the IT software industry and high demand for employees are also reflected in the respondents' predictions for the next year, according to which they estimated an increase of the number of employees by 13% by the end of 2018.

More than half of the companies from the sample have formal contractual relationships with international partners. Joint venture and license agreements are the most common forms of cooperation with foreign partners. The quality of services offered is the most important factor in the process of forming international partnerships. More than 57% of companies in the software industry conduct sales abroad, out of which approximately half of the companies achieve foreign sales of up to EUR 50,000.

Although many Serbian companies are focused on outsourcing, some have developed their own products, which are mostly produced for the Western markets. More than 70% of the companies in the software industry are working on coding; the least present activities within the value chain are marketing and sales (42% of companies).

Respondents' predictions for the future focus on an upward trend and high demand for highly qualified personnel. Landing in new markets and developing new products/services for the domestic and foreign markets are the next steps indicated by a large number of companies. In order to expand and develop the sector in the future, governmental regulations should change, according to the respondents. The most important constraints for future development opportunities indicated by the respondents are: high expenditure on taxes and contributions and unfavorable general conditions in the domestic market.

Innovation and competitive position of Serbian software companies

More than 70% of the companies have introduced innovations over the last seven years. Cooperation with the R&D sector in the country is at a very low level, given that only one

Table 4: Characteristics of companies in the software industry

Characteristics		Total (%)
Age of the company	1–3	7.8
	4–7	13.7
	7–10	31.4
	More than 10	47.1
Region	Belgrade	49.0
	Vojvodina	30.6
	Šumadija and Western Serbia	10.2
	Southern and Eastern Serbia	10.2
Type and size of the companies	SME <= 10	65.12
	SME 11–49	20.93
	SME 50–249	9.30
Ownership	Private	94.6
	State	5.4

Source: Authors' own calculations based on data from the survey.

third of the companies reported R&D collaborations. Despite this lack of collaboration, more than 60% of the companies conduct their own research and development. The level of networking through clusters is also at a low level; only 36% of the companies are members of any cluster in the country (Table 5).

The competitive position of software companies in the domestic market is based on three factors: specialized expertise in the field, previously acquired reputation and good quality of products and services provided. On the other hand, their position in the domestic market is weakened by a lack of developers and designers. Generally, the shortage of skilled labor and risk of fluctuation of IT experts are the most important challenges of the software industry in Serbia.

Company positioning and achieving a competitive position in international markets is determined by the quality of the products and services and the extent to which they meet the users' needs, specialized expertise, previously acquired reputation and programming skills. The most important limiting factors in international markets are lack of qualified labor, weak marketing and small supply.

According to the respondents' observations, lack of skilled labor and the risk of high fluctuation of IT experts are the most important obstacles for further development and growth of companies operating in this sector. In addition to this, there are also barriers which refer to market conditions and the tax system in the country:

- high labor costs due to outsourcing,
- high level of contributions for salaries,
- unfair tax system, favoring domestic companies operating abroad,

- impossibility to publish software products (applications) on Google/Apple store from Serbia,
- taxation of the marketing budget that exceeds 10% of revenue.

Government measures

The performance of companies is partly conditioned by governmental policies. With regard to specific measures that should be introduced by governments, most of the companies consider that direct support to R&D and innovation in companies and entrepreneurship programs would affect the companies in the following few years. The following measures are proposed by the software companies:

- incentive measures for exporters,
- reduction of fiscal and para-fiscal burdens,
- elimination of politically preferred suppliers,
- reducing corporate income tax and contributions for the salaries of new employees,
- reducing the unfair relationship between taxes on regular employment and employment of people through intermediary agencies,
- support to domestic entrepreneurs through incentives in employing and taxation,
- reducing corruption at the highest levels and creating better conditions for smaller producers,
- long-term incentives, innovation incentives, incentives to establish cooperation between local firms with a new product.

The survey results clearly show how the lack of skilled staff deteriorates the growth potentials of the software industry in Serbia. According to the survey respondents, adjusting the education system to the needs of the software

Table 5: Innovation management and research and development in the companies

Innovation and research and development in the company		Total %
Has the company introduced any innovation since 2010?	Yes	72.73%
	No	27.27%
Does the company cooperate with science and research organizations - universities, institutes and research and development centers?	Yes	30.30%
	No	69.70%
Does the company conduct its own research and development?	Yes	63.64%
	No	36.36%
Is the company a member of a cluster?	Yes	63.64%
	No	36.36%

Source: Authors' own calculations based on data from the survey.

industry should be a clear priority measure. Modernizing curricula and increasing enrolment rates for IT studies are considered to be very important for the sector, as well.

The Government should be doing more for the IT software sector when it comes to education, particularly to increase the offer in the market by educating more IT specialists at faculties, colleges and secondary schools. The increase of students enrolling at IT studies has occurred owing to the rising popularity of the IT profession among young people. The current capacities of Serbian universities to accept informatics students should be increased dramatically. Even if the education system suddenly increased the enrolled numbers of coders, developers and software engineers – it would not be enough to meet the needs of the IT industry.

Serbia's higher education system does not match the labor market needs. There is a need for curriculum change in higher education, since software engineers, designers and solution architects should possess more profound knowledge in certain areas of IT engineering. The introduction of programming in elementary schools has already begun, but it is necessary to continue in this direction and to further improve the curriculum.

SWOT analysis of the software industry in Serbia

For the purpose of completing the SWOT analysis, the following major aspects in the identification and analysis of opportunities and barriers of IT software industry in Serbia have been considered:

- Human resources,
- Domestic market,
- International market,
- Environment - Government measures.

Each aspect was examined by identifying the related strengths, weaknesses, opportunities and threats. Results of the SWOT analysis are presented in Table 6.

Future trends in IT software industry in Serbia

Future trends in IT software industry are determined by the existing structure, scientific and technological prospects, capacities and potentials for innovation and market competition, but conditioned by resources and internal weaknesses. There is a wide agreement on these trends among managers of major companies, leading researchers, Government officials and experts in the sector.

The software industry in Serbia is characterized by a high number of SMEs and freelancers, while the number of large companies is negligible. Nevertheless, the number of large companies in Serbia has been increasing since the beginning of the 21st century. Many of these companies have more than one thousand employees and several hundreds of software specialists. Special attention should be given to activities focused on the development of specific products and services, rather than outsourcing and simple programming services that were mainly present in the first decade of this century – domestic companies strive to compete both in domestic and international markets with specific expertise, knowledge and skills, with growing successes in niches such as gaming, entertainment and media, efficient management of large infrastructure networks (big data, distributed data systems), supercomputing (modelling complex systems, visualization), smart printing, development of next-generation encryption technologies, sector-wide integration built around data acquisition and management (particularly in agriculture, health and environmental applications) and robotics.

General trends in science and technology will shape the key programming activities and orientations toward specific products and services which companies will offer in the near future: data science, data security, cyber security, virtualization of goods, Internet of things, robotics, artificial intelligence, machine learning, graphics processing units and other hardware accelerators, distributed computing infrastructures, new parallel programming languages, 3D modelling, virtual reality, embedded systems, smart grids, cloud-based services, big data analytics, deep learning, pervasive computing, data business and electric cars.

The strategic orientation of the country toward digitalization of economy and society will strongly influence the future of the software industry in Serbia: omnipresence of IT, demand will only grow; efficient functioning (of enterprises, the Government, large infrastructures); digitalization (cultural heritage); logistics

Table 6: SWOT analysis of the software industry in Serbia

Strengths	Weaknesses
Human resources • well-educated researchers and software professionals • highly qualified, motivated and innovative workforce • good engineering skills and mindset **Domestic market** • IT and software sectors are the leaders in Serbia's economy in terms of annual growth rate • considerable number of R&D software companies in Serbia **International market** • cultural similarity with Western countries • proximity and time zone in line with almost all EU Member States • good command of English language within the sector • lower labor cost as a competitive advantage compared to EU countries **Environment - Government measures** • political stability	**Human resources** • lack of skilled labor in the market - "shallow" labor pool • lack of high-quality junior and senior developers - the entire sector is growing faster than the inflow of new IT graduates and experts **Domestic market** • low interest in IT industry for collaboration and research projects with universities • lack of budget for research activities, as well as for developing human resources in research and higher education • level of development of broadband infrastructure is very low • focus of software companies mainly on exports, rather than on driving the local market **International market** • insufficient knowledge and skills for international market penetration • command of other languages (German and French) is significantly weaker compared to English **Environment - Government measures** • absence of appropriate legislation • lack of computer literacy among Government officials, as well as in the wider population
Opportunities	**Threats**
Human resources • growing interest of young people in ICT studies • increase of enrolment quotas **Domestic market** • small size of IT software companies allows for easier transition into agile/collaborative mode of support to their end users • relatively low price of doing business in Serbia compared to EU Member States • potential for growth - Serbian ICT sector is still far from the saturation point • IT is a general-purpose technology and can be applied in all sectors **International market** • capability of producing top-quality and highly innovative software solutions, as well as all necessary services, know-how, and applied research capabilities • geographical proximity to the European market opens up outsourcing potentials **Environment - Government measures** • recognition and substantial support of the Government of Serbia to the IT sector at the highest level (both political and financial support) • political stability and economic growth of Serbia as a country in its final stages of accession to the EU • harmonization of legislation and online payment procedures • introduction and implementation of e-government and computerization programs on national and regional levels • matching the Serbian education system with economy (market) needs	**Human resources** • brain drain • insufficient inflow of new programmers and graduates **Domestic market** • great inflow of foreign IT companies might put serious strains on the existing IT labor market **International market** • uncertain sources of funding, such as venture capital • legislation and online payment: technical inability to pay in foreign currency - only RSD can be obtained from banks; because these are domestic companies, only dinars can be used for online payments **Environment - Government measures** • governance and regulation: legal and financial framework conditions taxation for small companies and start-ups • lack of trust in the promises of the Government

Source: Summarized by the authors on the basis of the results from the survey.

(public procurement, transport, pharmaceuticals, defense); Industry 4.0; and the transformation of the electric power system. Interest in this domain is on the rise, since many foreign ICT companies have already established their branches in Serbia and are attracting highly qualified and well-educated young employees. The local start-up culture is also improving, with an increasing number of start-up companies.

Capacities and potentials for innovation are already in place, since computer programming reached the first position in Serbia for the years 2015 and 2016 in a ranked list of all NACE groups in the country – this comparison is based on input-output indicators of economic, technological and innovative performance [10].

Major restrictions and obstacles for future development of this sector in Serbia are related to the lack of human resources: brain drain is enormous and is growing; particularly the young graduates are attracted by better professional prospects in the EU and North America – software specialists are in high demand worldwide. Further growth is significantly hampered by the increased scarcity of ICT professionals and the competitive pressures in the global labor market. Given the rising salaries and costs in Serbia for IT professionals, local companies that operate only in the domestic market will have to make significant efforts to stay competitive. Coupled with unfavorable demographic trends in Serbia, it will be difficult to overcome these constraints. Prospects for changing this are rather uncertain.

One particular obstacle is the lack of entrepreneurial and intellectual property rights culture, as well as the fear of business failure and competition, both domestically and in international markets. These specific obstacles could be reduced by improving the quality of education and through more openness to global markets, following the examples of an increasing number of success stories, and growing importance for national GDP and development of the economy and society in Serbia.

Finally, concerning the future trends of the IT software industry in Serbia, it is worth to mention specific "business dreams" of managers and software specialists in Serbia based on the survey results: selling a company for a significant amount, traveling around the world and starting a new business; running a company with many employees; promoting science, entrepreneurship and art in the vicinity – in Serbia and the region; making positive changes in the country in general; becoming the standard by which game developers measure their results; becoming one of Europe's unique companies; and placing Serbia on the world map.

Conclusion

Results of this study have confirmed that the software industry has been the most dynamic and fastest growing sector in Serbia in the recent years. The business model of most software companies is changing from outsourcing and simple programming services, which dominated in the first decade of the 21st century, to developing their own products. In the period from 2010 to 2015, the total turnover and number of employees in the software industry have more than doubled, which underscores the emerging character of this sector in Serbia. The Belgrade region and Vojvodina are the most developed regions in terms of employment and turnover. Although numbers of employees in Šumadija and Western Serbia and Southern and Eastern Serbia are substantially lower than in Belgrade and Vojvodina, employment growth is visible in these regions, too.

The software sector is characterized by a high level of internationalization and innovation. In order to stay competitive in international markets, permanent innovation of products and services is necessary. Cooperation with R&D institutions in Serbia is at a very low level, as is networking through cluster organizations. Only one third of the companies have established some kind of collaboration with the R&D sector and are members of clusters. The most important sources of competitive advantage of companies operating in this sector are the good quality of the products and services, ensuring high responsiveness to the needs of new users, specialized expertise in the field and previously acquired reputation and programming skills. Generally, lack of skilled labor in the market, risks of fluctuation of IT experts and weak marketing are the most important challenges of the software industry in Serbia.

Respondents in our survey underlined that the Government should be more supportive of the software sector when it comes to education, particularly to educate more IT specialists and to change curricula in higher education. The Serbian Government recognizes the potential of the software industry and its contribution to the economy. However, it will be important to introduce specific measures in order to create meaningful support structures and programs. Some of the proposed measures are incentives for exporters, reduction of fiscal and para-fiscal burden, more transparent public procurements, reducing corporate income tax and contributions for the salaries of new employees, reducing the unfair relationship between taxes on regular employment and employment of people through intermediary agencies.

The country's strategic orientation toward the digitalization of economy and society will have a particular influence on the future of the software industry in Serbia. Our survey results reveal indications that the software industry in Serbia is likely to grow further. This provides a window of opportunity for governmental actions that can yield significant impact on the ICT sector with substantial spill-over potential to the more established industries.
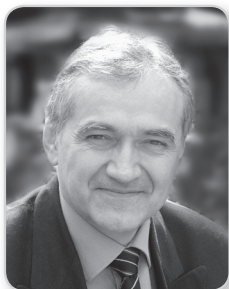
References

1. European Commission. (2013). *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: DG for Communications Networks, Content & Technology.

2. Barrios, S., Mas, M., Navajas, E., & Quesada, J. (2008). *Mapping the ICT in EU regions: Location, employment, factors of attractiveness and economic impact.* Brussels: JRC – Institute for Prospective Technological Studies (IPTS).

3. JRC. (2010). *The 2010 report on R&D in ICT in the European Union.* Brussels: JRC - IPTS.

4. JRC. (2013). *European ICT poles of excellence.* EIPE Working Paper 1. Brussels: JRC.

5. Kroll, H., Schnabl, E., & Horvat, D. (2017). *Mapping of economic, innovative and scientific potential in Serbia.* Karlsruhe: Fraunhofer ISI.

6. Matejić, V., Grečić, V., Mikić, O., & Kutlača, Đ. (1996). *Brain-drain from FR of Yugoslavia.* Belgrade: Federal Ministry for Development, Science and Environment, Institute Mihajlo Pupin & Science and Technology Policy Research Centre (STPRC).

7. Niebel, T. (2018). ICT and economic growth: Comparing developing, emerging and developed countries. *World Development, 104*, 197–211.

8. OECD. (2006). *Classifying information and communication technology (ICT) services.* Working Party on Indicators for the Information Society, DSTI/ICCP/IIS (2006)11/FINAL. Paris: OECD.

9. OECD. (2009). *Guide to measuring the information society.* Paris: OECD.

10. Statistical Office of the Republic of Serbia. (2017). Retrieved from: http://www.stat.gov.rs/.

Lazar Živković

graduated in 2009 from the Faculty of Organizational Sciences, University of Belgrade, in the field of management. In 2011, he obtained his master's degree from the Faculty of Organizational Sciences, University of Belgrade, in the field of financial management. In 2014, he enrolled at PhD studies at the University of Belgrade, Department of History and Philosophy of Natural Sciences and Technology. Since January 2012, he has been employed at the Institute Mihajlo Pupin as Research Associate at the Science and Technology Policy Research Center. Over the last six years, he has been a member of research teams in several national projects and more than 10 international R&D projects. He published numerous scientific papers both in international and national scientific journals and took part in a number of scientific and professional conferences. His specific professional fields of interest are: quantitative research methods, S&T and innovation policy, national innovation system, scientometrics

Đuro Kutlača

is Head of the Science and Technology Policy Research Center and Scientific Advisor at the Institute Mihajlo Pupin, University of Belgrade. He is Full Professor at the University of Belgrade, Department of History and Philosophy of Natural Sciences and Technology, where he teaches PhD courses: Science Policy and National Innovation System, Technology and Transition and Methodology of Scientific Research. He was Visiting Researcher at FhG Institut für Systemtechnik und Innovationsforschung, Karlsruhe, Germany (1987; 1991-1992) and at the Science Policy Research Unit, University of Sussex, Brighton, UK (1996; 1997; July 2001-October 2002). He is a former member of NESTI (National Experts for S&T Indicators) group at OECD (1988-1992). During 37 years of research experience, he was member of research teams in 48 large R&D projects, published 38 scientific papers in journals, and presented 149 papers at international and national scientific conferences. He authored 4 and co-authored 27 books. He is Coordinator of national scientific projects financed by the Ministry of Education, Science and Technological Development and Project Manager of international projects funded by various EU programs. Professor Đuro Kutlača is member of the Program Council at the University of Belgrade and an active business consultant in the field of enhancing innovation capacity of enterprises. His specific areas of research interest are: S&T and industry development and policy, metrics in S&T and innovation, and innovation theory and practice. He has been organizing the Scientific conference "Technology, culture and development" since 1994 and is Chair and/or member of program committees of numerous scientific conferences.

Alexander Kleibrink

is Senior Policy Analyst and Team Leader at the European Commission's Joint Research Center. He works in the field of strategic public management, regional development and innovation processes. He was Research Fellow and Lecturer at the Free University of Berlin and the Hertie School of Governance, Germany's largest public policy school. Among other, he has been Chief Editor for the successful application of a EUR 10m research project funded by the European Commission's 7th Framework Program. He teaches regularly on EU governance, place-based innovation and policy analysis. Alexander graduated with highest honors from the Free University of Berlin. He holds a Master's Degree in Public Administration from the London School of Economics. His previous work experience was with the German Federal Ministry of Finance, London-based think tank Demos and the UN Office on Drugs and Crime.

Dijana Štrbac

is Research Associate at the Institute Mihajlo Pupin, Science and Technology Policy Research Center, and PhD candidate at the Faculty of Economics, University of Kragujevac. Her primary areas of interest are economic development, innovation and industrial policy. She is author and co-author of more than 30 papers published in national and international journals and conferences. Dijana Štrbac has been involved with the implementation of national research projects funded by the Ministry of Education, Science and Technological Development and a significant number of international projects funded by various EU programs. The projects are related to innovation, education and research policy, support to entrepreneurship and technology transfer. She is member of the Coordination Team managing Priority Area 7 (Knowledge Society) of the EU Strategy for the Danube Region.