ICT in Serbia

At a Glance
2018

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Acknowledgments

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РЕПУБЛИКА СРБИЈА
АУТОНОМНА ПОКРАЈИНА ВОЈВОДИНА
Покрајински секретаријат за привреду и туризам

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Foreword

Milan Šolaja, CEO
Vojvodina ICT Cluster

Hello world!

"You journalists should pay more attention to what is going on. Everyone is writing about Serbian export of raspberries as a huge national success, and nobody knows that we export more software than raspberries." It was in the early 2011 that yours truly has exasperatedly said this to a journalist on the margins of the DanubeIT Conference in Novi Sad. The very next day, there was this big headline: "SERBIA EXPORTS MORE SOFTWARE THAN RASPBERRIES!" and raspberries have been fused to software topics in media ever since.[1]

In the previous edition of this study two years ago, we wrote about the advancement of the Serbian IT industry and its steady growth. Ever since, this trend has maintained a double-digit growth year-on-year and, for the first time ever, in 2017 the Serbian export of IT services is larger than the export of maize. This came as no surprise to the IT businesses, but it really shook things around in Serbia. However, it means different things to different audiences.

For young generations, this trend is a confirmation of their interest in new technologies and an additional incentive to focus on this field, enroll IT and related studies, think up startups, learn and evolve. The number of developers' communities has increased significantly, and they organize meetups and conferences, bring them up to date with the latest development in their special fields, share experience and excel.

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1   Serbia is one of the top three global exporters of raspberries, and definitely the top one in terms of quality of that berry.

For traditional businesses, it is the wake-up call. Modernizing small and medium enterprises – the major contributors to GDP, tax revenues, and employment – is a "make or break" challenge. Those who boldly jump on the bandwagon of digitization and use opportunities of automation, e-commerce as well as the global marketing opportunities, will not only survive, but become the motor of economic progress. If we take a look at the IT investments per capita, it is at €62 in Serbia – a mere fraction of the EU average of €800. This figure is an important indicator of general implementation of standards and new technologies in any country. As such, it shows that much more has to be done in Serbia to push economic and every other development forward.

This is a huge challenge for the Government, but also an opportunity. Current activities would suggest that the authorities are doing their best to respond to this challenge and use that opportunity: Serbia has gotten a young Prime Minister, knowledgeable and close to the IT sector throughout her career – and for the first time ever, a Serbian Prime Minister has devoted a significant part of inauguration exposé to IT-related topics. A new inter-ministerial body – Ministerial Council for IT and Innovative Entrepreneurship has published the Plan of Priority Goals and Activities of All Governmental Bodies and Services for the Advancement of the IT Sector in Serbia in 2018,[2] Science and Tech Park in Belgrade has started to operate,

while several are being constructed in other cities. Our feeling is, however, that a well-defined vision for the role of IT in general socio-economic development is still missing. Also, concrete decisions that would declare, loud and clear, future actions and targeted outcomes is painfully lacking.[3]

For many IT companies, this growth meant enlargement and corporatization. The major trend is moving away from the general outsourcing.[4] The cause for this trend stems from a chronic lack of IT skills in the labor market, which slowly but surely drives the salaries up, turning companies away from lower-paying contracts and toward specialization and/or niche markets/clients in order to maintain their ability to afford IT skills and still secure profit. More than 2,000 IT startups were founded in 2017, which indicates to a greater interest and courage to plunge into entrepreneurship – despite the fact that there is still a very week eco-system of support for entrepreneurship in the country. Many of the local IT companies joined and incentivized this trend by either spinning off new companies or investing in new startups. We would argue that more visibility of IT business in general, rise of profits that IT companies diverted into startups, and well-known success stories, significantly contributed to this trend.

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2   http://vojvodinaictcluster.org/plan-prior-aktiv-saveta-za-ip-it-za-2018-271217

3   See The Mission Manifesto at www.vojvodinaictcluster.org/mission_manifesto/.

4   General outsourcing here means accepting any job/project that comes along, claiming your company is able to answer to requirements in an array of diversified business areas and/or IT platforms.

Vojvodina ICT Cluster is in its eighth year of operation, and in the previous couple of years we worked a lot on bringing IT to other sectors – showing the way in which IT could transform businesses. We used EU funds to help connecting IT and agriculture in two projects: FRACTALS and KATANA.[5]

For foreign investors and IT companies coming to Serbia, there are some great opportunities for takeover, merger and b2b cooperation. Outsourcing to Serbia has been popular for years now and, as local companies grew and matured over time, opportunities to extend this cooperation were used for JVs, joint research and mergers. Many local companies used these opportunities to corporatize and learn from the already established partnerships, bringing them to the next game level.

And so, our long-term goal of Serbia as the prime choice for development of sophisticated software and the hotbed of regional IT is still very much in the focus. We continue to join forces with other players and in 2018 the existing Strategic partnership of Serbian IT Clusters has been expanded to six clusters: Vojvodina ICT Cluster, ICT Network, NiCAT, ICT Cluster of Central Serbia, Subotica IT Cluster, and Zrenjanin ICT Cluster.[6] The Serbian IT clusters have become

more active on the international markets too, and in 2017 presided over the Balkan & Black Sea ICT Cluster Network.[7]

This study should give you a good overview of the Serbian ICT. Whether you are an investor or a scholar, a businessperson or a student – we hope you find this study useful. Please, feel free to contact us for more information and consultations One-On-One.

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5   http://cordis.europa.eu/project/rcn/191438_en.html
    and http://katanaproject.eu/
6   http://vojvodinaictcluster.org/, http://www.ict-net.com/language/en/home/, http://ni-cat.org/index.php/en, http://ict-cs.org/en/#, https://www.itcsubotica.org.rs/en, http://www.zrict.rs/,

7   http://bbs-ict.com/

Data source partner

(Data provider)

www.sito.rs

VOICT:
A PASSION FOR EXCELLENCE

Vojvodina ICT Cluster – VOICT provides a single point of contact with the best companies in Serbia, with the total workforce of 4,000+ experienced IT professionals working in our member companies. We build long-term relationships based on trust and quality, bringing expertise, experience and passion for excellence to each and every project.

The vision of Vojvodina ICT Cluster is Digital Serbia – an environment with strong support to export-oriented IT industry, as well as active usage of IT products and solutions for the benefit of economy and society as a whole. The member companies made a noticeable breakthrough on world markets, putting Serbia on the map as a very interesting alternative location for the development of sophisticated software. Vojvodina ICT Cluster gives institutional support to this trend, while the strong support from the University of Novi Sad adds to the strength of the cluster.

An important strategic objective of Vojvodina ICT Cluster is to increase visibility of Serbian ICT and put Novi Sad on the regional and European map as the hotbed for ICT in this part of the world. Activities toward this objective include further strengthening of the association, its positioning as the most relevant Serbian ICT institution within the country and abroad, building ever stronger network of international contacts, creating new business opportunities for the members, compiling and delivering sets of services to members and third parties, lobbying for improvement of the business environment in Serbia, and popularizing ICT both in terms of generating

more ICT professionals and enabling more penetration of these technologies throughout other sectors of Serbian economy.

The cluster has its own Academy, organizing courses, presentations and lectures according to the needs of the members, as well as a separate Project Office that grows its projects portfolio and revenues every year, making Vojvodina ICT Cluster leader in excellence among organizations of this type in Serbia.

Facts & Figures

40+ members	**4,000+** employees

€7+ million
worth of EU, bilateral and national projects

1,200+
students of the Cluster Academy, including 350+ kids learning to code, 120+ people re-trained to start IT careers, and hundreds trained in Scrum, software testing, and soft skills.

The vision of Vojvodina ICT Cluster is Digital Serbia – an environment with strong support to export-oriented IT industry, as well as active usage of IT products and solutions for the benefit of economy and society as a whole

GIZ: Working together worldwide

The wide range of services offered by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH are based on the wealth of regional and technical expertise and on tried and tested management know-how. We are a German federal enterprise and we offer workable, sustainable and effective solutions in political, economic and social change processes.

Most of our work is commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ). However, GIZ also operates on behalf of other German ministries and public and private bodies in Germany and abroad. These include governments of other countries, European Union institutions, such as the European Commission, the United Nations and the World Bank. We are equally committed to helping our clients in the private sector attain their goals.

Private Sector Development in Less Developed Regions in Serbia (PSD)

PSD is a module implemented by GIZ on behalf of the German Ministry for Economic Cooperation and Development (BMZ). It aims to improve the competitiveness and innovative capacity of Serbian micro, small and medium-sized enterprises (MSMEs).

The project is actively working in different fields with the purpose to strengthen the public and private service providers and support MSMEs and the relevant line ministries. In order to reach the objective, the project is engaged in the following fields:

Facts & Figures

GIZ operates throughout Germany and in more than 120 countries worldwide. Our registered offices are in Bonn and Eschborn. We have 18,260 staff members around the globe, almost 70% of whom are employed locally as national personnel. GIZ's business volume was over EUR 2.4 billion as of 31 December 2016.

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Improvement of the generic service offer for support of MSMEs through:

- Trainings regarding technical requirements, CE mark and Serbian mark of conformity, export management, access to finance.
- Development of capacities of the Serbian Chamber of Commerce and Industry (PKS), like implementation of management by objectives; management and analysis of members' interactions and data, instruments for the public-private dialogue.

Support of the service offer for MSMEs in the selected value chains:

- Support to MSMEs in enhancement of B2B relations in specific sectors: IT, metal and mechanical engineering and organic agriculture, which will result in the improvement of their business performance. The promotion of new start-up business models in less developed Serbian regions will encourage entrepreneurship, while the implementation of new IT solutions aims at increasing the MSME productivity.
- Support to the digital transformation process through expertise and technology transfer in agriculture, mechanical engineering and IT sector.

Elaboration of a national industrial policy:

- Contribution in drafting the national Industrial Policy Strategy by providing advisory services to the Serbian Ministry of Economy (MoE), with a focus on incorporating the private sector needs, mainly of MSMEs in the selected sectors.

Beside these fields the project is also active in:

- Strengthening the women's entrepreneurship through start-up trainings for female entrepreneurs, support of the mapping of organic and traditional food procedures in Western and South Serbia and the organization of the Promotional event "Success Flower" 2018

Introduction

Information and Communication Technologies (ICT) undoubtedly constitute one of the key innovations of the last century. ICT are comprised of a wide range of product and service technologies including computer hardware, software and services, and a host of telecommunication functions. ICT strongly influenced the fields of socio-economic development, international development, and human rights. The basic hypothesis behind the approach is that information and communication furthers the development of a society (be this to improve income, education, health, security, or any other aspect of human development).

Various studies define the ICT sector differently. The OECD defines ICT sector as a combination of manufacturing and service industries, whose products electronically capture, transmit, or display data and information. In addition, "The production (goods and services) of a candidate industry must primarily be intended to fulfill or enable the function of information processing and communication by electronic means, including transmission and display" (OECD, 2007). This also includes the production of electronic components.

In this report, the traditional and simple definition of the ICT sector will be applied. 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, which are hardware, software, and services. The main reasons for choosing this definition are: clear and simple overview of particular sub-sectors, which have not yet significantly converged

in Serbia, and since it is the focus of this study, to enable presentation of Software sub-sector characteristics.

Table 1 ICT Sector Definition

The shortest description of the Serbian IT market would be: huge growth potential on a small base. The official start of negotiations in the EU accession process has undoubtedly had a big significance for Serbia, but it is even more significant to meet the standards that are expected in 35 chapters.

The postponement of the IT projects caused by the economic crisis created a barrier, which, in turn, led to the accumulation of a great

potential. With the improvement of the present economic situation and after having removed these barriers, this accumulated potential will be given a chance to express itself through double-digit growth, again. This study presents an overview of the ICT sector in Serbia. The analysis is structured into three thematic areas: General Business Environment, Assessment of the ICT Sector, Software Sector – Opportunities on the International Market.

The study, with its analysis and information, has been designed to serve primarily the companies interested in business and investing related to ICT in Serbia.

Table 1: ICT Sector Definition
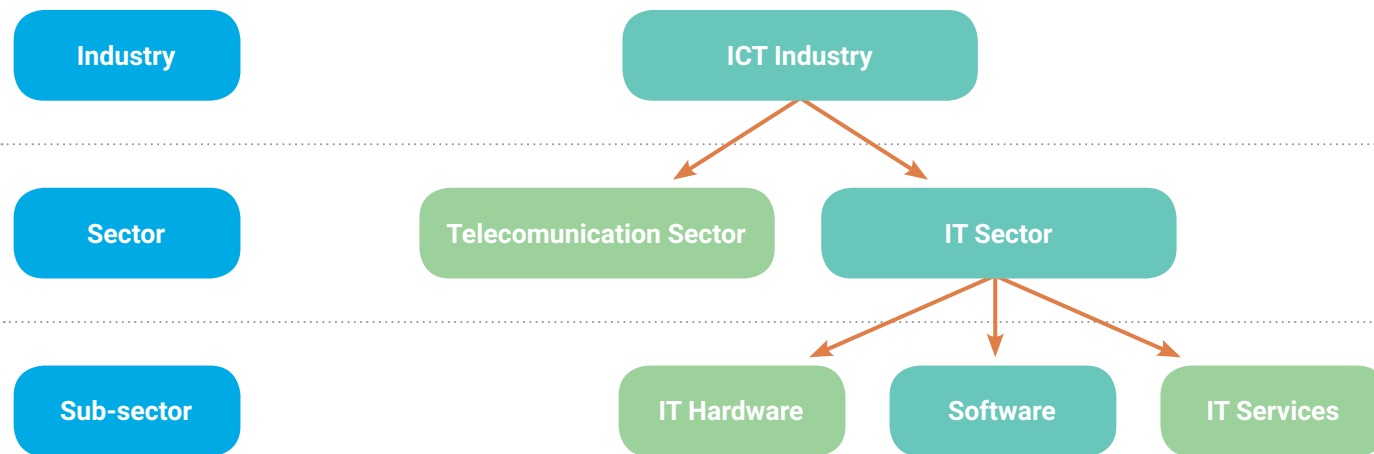
General Business Environment

This chapter provides the following information: overview of current business environment in Serbia and legislation framework – in general and IT related.

General Statistics
Population (millions): 7.1
Capital: Belgrade
Territory area: 88,361 km2
GDP (US$ billions): 37.7 (per capita: $5,376)
GDP (PPP) per capita (US$): 14,493
GDP (PPP) as share (%) of world total: 0.09
68.1% of households have personal computers
68.0% of households have Internet access
90.5% of households have mobile phones
130 Mobile telephone subscriptions/100 pop
36.0 Fixed telephone lines/100 pop; 99.9% digitalized network
Percent of GDP spent on R&D: less than 1.0% (Government fund estimated on 0.6%)
Percent of GDP spent on Education: 2.4%
Source: Statistical Office of the Republic of Serbia

Current Business Environment in Serbia

Eighteen years after the democratic changes, **the Serbian economy is still in transition**, on a roller coaster ride between years of growth and recovery and economic stagnation. Although the Serbian economy had a healthy growth during the 2004-2007 period, with an average GDP growth rate of 6.8% (with peaks of 8.4% in 2004 and 7.5% in 2007), it reached only 70% of the country's GDP from 1990. In the period of still lasting economic crisis (2009-2017) the Serbian economy is mostly stagnating. According to the World Bank estimates, even with a solid annual GDP growth, it will be many years before Serbian GDP reaches previous levels.

In 2017, Serbia has managed to regain BB level (Standard and Poor's) credit rating from 2012. Two more steps are needed to reach the investment level.

According to the European Commission, with regard to the economic criteria, Serbia is moderately prepared in developing a functioning market economy. Good progress was made to address some of the policy weaknesses; in particular with regard to the budget deficit (0.2%) and restructuring of publicly owned enterprises. Economic reforms have brought clear results in terms of growth prospects and reduction of domestic and external imbalances. Fiscal consolidation needs to be sustained in view of the still high level of the Government debt. The restructuring of large state-owned utilities is still to be completed. Credit activity is recovering but the high level of non-performing loans remains an issue. Unemployment remains high (15%), particularly among young people. Further expansion of the private sector is hampered by weaknesses in the rule of law.

To overcome the situation, **economic development policies in Serbia mainly focus on the attraction of FDIs**. According to the National Bank of Serbia (NBS), in the period from 2010 to 2016 net FDI amounted to €11.4 billion, with the maximum of €3.3 billion in 2011.

In the past two years the investments recorded averages not exceeding € 2 billion per year. The waning interest of investors is not characteristic only of Serbia but of the entire region of Western Balkan countries. The main reasons are the slowed process of joining the EU, and the global economic crisis. However, foreign investors, among the key reasons for not having more FDI in Serbia, cite the stereotypes such as bureaucratic and insufficiently reformed public administration and a high level of corruption.

Evidently, Serbia is not among the top destinations for investment as the level of FDI remains low with or without the Government incentives. For example, one of the attempts towards the reduction of negative impact of the current economic crisis was the package of measures for foreign companies interested in setting-up their businesses in Serbia. Although it has one of the lowest corporate taxes rates in Europe (15%), the Serbian Government was giving grants of up to €10,000 per employee. Contrary to the expectations, this has never produced much positive effect. So, the tax rates were returned to 15% and increase to the grants for new jobs abandoned.

It is unrealistic to expect the FDI increase in Serbia in the current exacerbation of the geopolitical situation in Europe. However, there are other opportunities, such as the estimation that during the observed period 2010-2016, remittances from Serbian diaspora were at least twice as high as the FDI. So, incentives in this area could be a possible way to compensate for the missing FDI.

For a time, incentives were available for FDIs in the IT sub-sector, which did not make much sense as it gave unfair advantage to companies receiving incentives, in the environment with almost non-existing unemployment. Representatives of IT community took this argument to the Government and IT sub-sector was removed from the FDI Directive in 2017.

Global IT Index of Serbia

According to the World Economic Forum, the information and communication technology acceptance, infrastructure, and innovation in Serbia are not sufficiently developed, so the capacity for increasing the national competitiveness - is limited. According to the WEF index of technological readiness, in the list of 139 countries, Serbia is ranked 75th, which is the third lowest rank in Europe. Behind Serbia are only Albania (84) and Bosnia and Herzegovina (94), while above are better positioned Serbia's neighbors - Bulgaria (69), Croatia (54), Montenegro (51). Macedonia is positioned a whopping 29 places ahead (46)!

Observing the picture of the international ranking raises some questions: why is Serbia positioned in this unfavorable environment, and what are the key factors affecting such poor ranking. Serbia has a noticeably better ranking when it comes to quantitative indicators (comparable statistical data that exist for each of the observed countries) in comparison to qualitative indicators (opinions and attitudes that WEF collects through surveys by local agencies).

Respondents from Serbia, in almost all questions from the surveys, express noticeable criticism and significantly underestimate domestic technological readiness in comparison to the vast majority of their colleagues from around the world.

Qualitative indicators, which are the result of the attitudes and opinions of respondents, classified Serbia on 116th place, which deviates to a large extent from 56th place where Serbia is ranked according to the "clean" statistical (quantitative) indicators. The resulting average rank (75) is standing alone between two distant poles, which leads us to the conclusion that this approach to rank calculating has methodological limitations and, in the case of Serbia, it offers a picture that is not objective. What is more problematic, the result of the quantitative analysis is almost regularly repeated in all international comparisons that contain surveys with respondents' views and opinions. Significant discrepancies between qualitative and quantitative indicators point to criticism of those surveyed, which could be positive as respondents wish their situation to be improved, but could lead to wrong general conclusions.

Table 2: Network Readiness Index 2016. Serbia Profiles

	Rank (out of 139)	Value (1-7)
Networked Readiness Index	**75**	**4.0**
Networked Readiness Index 2015 (out of 143)	77	4.0
Networked Readiness Index 2014 (out of 148)	80	3.9
Networked Readiness Index 2013 (out of 144)	87	3.7
A. Environment subindex	**103**	**3.7**
1st pillar: Political and regulatory environment	110	3.2
2nd pillar: Business and innovation environment	82	4.1
B. Readiness subindex	**48**	**5.2**
3rd pillar: Infrastructure and digital content	45	4.9
4th pillar: Affordability	56	5.6
5th pillar: Skills	61	5.2
C. Usage subindex	**79**	**3.7**
6th pillar: Individual usage	54	4.9
7th pillar: Business usage	125	3.1
8th pillar: Government usage	106	3.3
D. Impact subindex	**89**	**3.4**
9th pillar: Economic impacts	79	3.1
10th pillar: Social impacts	93	3.6

Source: WEF, Network Readiness Index (NRI) for 2016-2017

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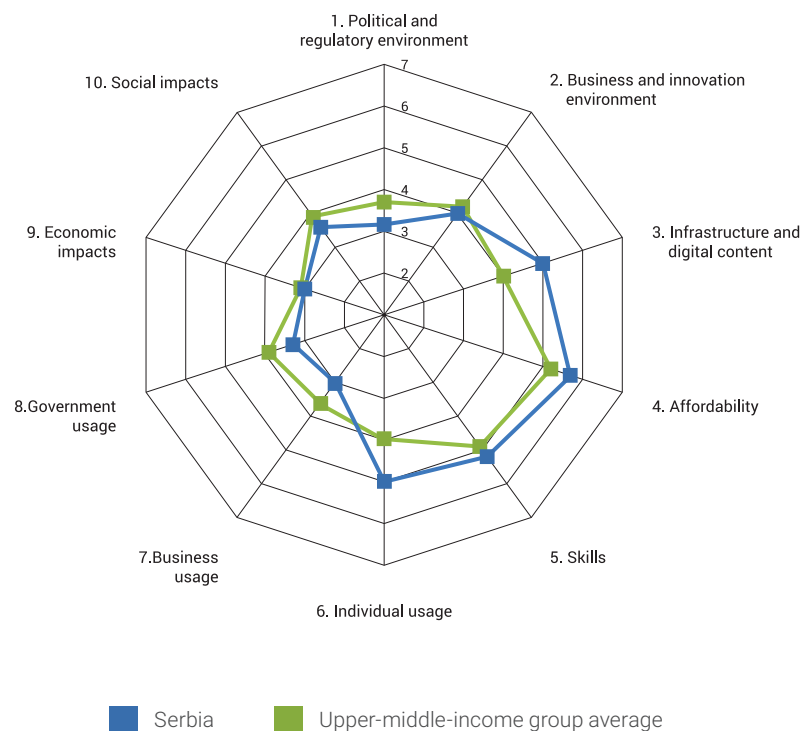
Table 3: Discrepancies between Qualitative and Quantitative (*) NRI Indicators Selection 2017

1st pillar: Political and regulatory environment	Rank/139
1.03 Judicial independence	122
1.08 No. procedures to enforce a contract*	58*
2nd pillar: Business and innovation environment	
2.01 Availability of the latest technologies	107
2.05 No. procedures to start a business*	54*
2.07 Tertiary education gross enrollment rate, %	44*
2.08 Quality of management schools	116
2.09 Gov't procurement of advanced tech	109
3th pillar: Infrastructure and digital content	
3.02 Mobile network coverage, % pop.*	54*
3.03 Int'l Internet bandwidth, kb/s per user*	26*
5th pillar: Skills	
5.01 Quality of the educational system	110
5.04 Adult literacy rate, %*	48*

6th pillar: Individual usage	Rank/139
6.02 Individuals using Internet, %*	65*
6.03 Households w/ personal computer, %*	50*
6.06 Mobile broadband subscriptions/100 pop*	36*
7th pillar: Business usage	
7.02 Capacity for innovation (1-7)	131
7.03 PCT patents, applications/million pop.*	49*
8th pillar: Government usage	
8.01 Importance of ICTs to gov't vision	114
8.03 Government success in ICT promotion	117
9th pillar: Economic impacts	
9.01 Impact of ICTs on new services and products	107
9.02 ICT PCT patents, applications/mill pop.*	44*
9.03 Impact of ICTs on organizational models	114
9.04 Knowledge-intensive jobs, % workforce*	46*

Source: WEF, Network Readiness Index (NRI) for 2016-2017

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WEF uses the index of technological readiness, which equally relies both on the survey results (qualitative indicator), and the statistically comparable data (quantitative indicator*), thus ignoring the substantial difference between these indicators. The much present bias in opinions and attitudes has a significant impact on the final ranking, which can partially explain the current relatively low Serbian position.

Taking into consideration Kant's thought that perception influences reality, it is not hard to understand the significance of WEF index of technological readiness influence on the picture that others have of Serbia as well as Serbia's picture of itself. The World Economic Forum analyses are the most widely accepted ones and the most covered international ranking in media in the past decade. Although WEF has informal authority, ranks are accepted both by experts and ICT policy creators alike. WEF evaluation creates a perception that affects reality. Because of that, a careful analysis of the WEF index of technological readiness framework is recommended.

Despite the undeniable importance for comparison of technological readiness of a large number of countries, the analyzed WEF model shows deficiencies and limitations for improving the technological position of any country. Therefore, it would be of great importance for Serbia to introduce additional indicators to better identify its national goals. The introduction of new statistical indicators would ensure more accurate overview of the current situation, especially of its real faults.

Where is Serbia on the EU Technological Map?

On the global technology map, Serbia is somewhere in the middle. This would be the shortest answer, but we need to take a look at the wider picture. Strong economies, such as US and Japan, are in leading positions, with the Atlantic EU members following them together with a handful of countries from the rest of the world. The well-known Pareto principle has another confirmation here, as 20% of countries make up 80% of total investments in the new technologies. A gap was created which rightfully marks the new era in capitalism – global information capitalism. For countries like Serbia, these circumstances create challenges of further increase of the digital divide, and a probable lag behind the developed countries in the coming decade. Consequently, the Serbian Government is obliged to lay foundations for future societal development and decrease that lag as much as possible.

Economic competitiveness as well as the society organization and transparency are best illustrated with the diagram of IT investment per capita according to economic strength (GDP).

Significant differences are noticeable among European countries in IT spending per capita, so classification into 6 groups (Tier 1 – 6) according to IT spending vs. GDP per capita is proposed. One of the main observations for the 2006 – 2016 period is validity of tiers robustness against yearly changes of input data. The tier model successfully detects groups of countries which significantly differ in

Figure 1: IT Investment according to Economic Strength (GDP), 2016
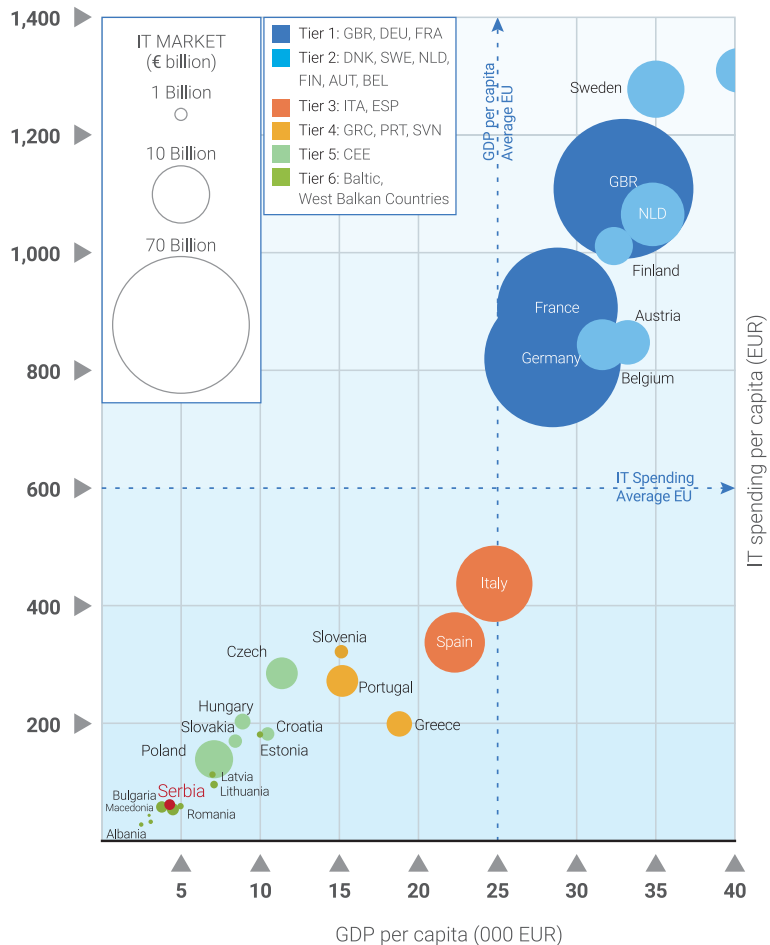
Source: Eurostat, EITO 2007, SITO 2016

their size and growth dynamics: **big and economically strong, grow faster**.

Key observations for the diagram above:

- The countries in the North and West of Europe have strong economies and high IT investments per capita (all significantly above average), showing a visible correlation in the two indicators (Tier 1 and Tier 2).
- PIGS countries (Portugal, Italy, Greece, and Spain) also have strong economies but low IT investments, putting them into the "second league" (Tier 3 and Tier 4).
- All the countries from EU 10 (10 new members as of 2004) lag behind: they are in the quadrant of weak economy and low IT investments (Tier 5).
- The rest are small IT Markets of the Western Balkan countries and the Baltics (Tier 6).
- Between Serbia and its northwest neighbors, there is a couple of decades of technological gap. Serbia is positioned near the base of both coordinates together with Albania, Macedonia, Montenegro, Bosnia and Herzegovina, Romania and Bulgaria.

Taking into consideration the key observations above, and treating the IT investments per capita as the early indicator of economic and social trends, it is useful to remind ourselves of the hypothesis by Milovan Matijević, IT Analyst: "The Serbian economy and society will avoid a further drop to an even deeper crisis if the IT investments grow from the present <1% of GDP to 2% of the GDP in the period

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Table 4: Key Parameters for the Serbian IT Market Forecast, in Q1-2018

Economic and Political Factors	Factor Power	Factor Value (Intensity)		
GDP growth projected up to 3% in 2018 (Source: World Bank)	3	25		
Insufficient investment. The flow of foreign direct investment slowdown	2	25		
Exchange rate. US dollar strengthened against the euro	2	25		
IT modernization - need for IT investment (yearly growth of at least 15% until 2020)	1	25	50	
Consumers				
Companies without a serious profit postpone their investments and IT investments	2	25	50	
Government institutions postpone large tenders	2	25	50	
IT replacement cycle. Annual delivery of more than 300,000 PC	1	25		
IT Market				
Companies' competitiveness decreasing. SME IT players in the growing problems	2	25	50	
Financing options (loans, leasing, etc.) for investments are getting weaker	1	25		

Source: SITO 2017

Legend: Factor Power:
3 – very strong factor;
2 – strong factor;
1 – moderate factor

Examples for Factor Value:

25	50	75	

Indicates a barrier for IT sales, which reached 75% of the maximum 100 % intensity

25	50	

Indicates a driver for IT sales, which reached 50% of the maximum 100% intensity

2011-2015. To jump the EU bandwagon, it is necessary to triple IT investments per capita in Serbia for the same period."

It is not hard to see that the similar task remains for the period until 2023, albeit in even more difficult circumstances.

IT Environment, Drivers and Barriers

Individuals with particular ideas have the best DIGITAL perspective in Serbia. Entrepreneurial individuals and businesses follow, while the state itself has the weakest position because individuals with enthusiasm are not sufficient for serious changes there. Reshuffling of such setup will remain a mission impossible as long as the Government steers away from the opportunities for modernization and transparency offered by new technologies. Therefore, Serbia remains an environment with few good opportunities, where individuals and businesses keep their focus on developed countries, and opportunities they offer.

From the perspective of local companies operating in the ICT sector, **FDIs are seen more as a threat than a benefit due to the limited human resources available on the market**. Namely, foreign companies tend to attract good ICT experts by means of higher salaries, often putting local companies in a situation where they cannot compete. Resulting destabilization of the local IT sub-sector does not benefit foreign IT companies who want to establish subsidiaries in Serbia either. The best way to go about FDIs in software business is to focus on JVs, joint research and b2b cooperation.[8]

Although **the quality of Serbian broadband Internet access is below the level of EU countries**, it has been getting better, improving impressively in the past few years. In addition, the quality of ICT infrastructure itself does not present significant obstacles for business in Serbia, since the most of the ICT companies are concentrated in urban areas where the quality of ICT infrastructure is up to high standards that allow undisturbed IT business. Serbia is still not taking steps to build a comprehensive national broadband infrastructure. A decisive action to construct public-owned fiber optic infrastructure readily available to businesses and citizens at low cost would have profound long-term effects. The most important one would be moving business environment up and away from competition in the field of physical infrastructure to the field of competition in quality of services. Such tremendous shift would bring about

huge positive and lasting effects on the economy. The plan needs to be created to streamline regulations, support to local communities, and investments toward construction of broadband infrastructure in the form of public utility.

In 2017, effort and investments were put forward into building Science & Technology parks in Novi Sad and Niš. This kind of infrastructure is of immense importance for future development of the Serbian IT sub-sector, and much more should be invested. Public-private partnership is an unused avenue to build more parks and IT-supporting infrastructures, but initiatives to that end fall on deaf ears with all levels of government.[9]

Standardization of the Serbian IT companies appears to be driven by foreign partners' demands. Standardization requirements are usually related to the nature of exported IT services. For example, embedded industry, which produces innovative goods in the field of medical appliances, requires sector-related standards.

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8 Using EU funded projects to establish cross-border cooperation is another excellent way to do it.

9 For example, Vojvodina ICT Cluster proposed PPP model for renovation of a multi-story building, burnt in a fire in 2000, still standing abandoned in downtown Novi Sad. The idea is to create *Business & Research Center Novi Sad – BRAINS*, which would gather companies and startups, academia and researchers, government and businesses – around projects and activities that would significantly boost local IT scene. See more at http://vojvodinaictcluster.org/sr/brains.

Legislation Framework

The European Council granted Serbia the status of the candidate country in 2012. The Stabilization and Association Agreement (SAA) between Serbia and the EU entered into force in September 2013. Accession negotiations were launched in January 2014.

Legislation and regulations have been improved in recent years. The process of streamlining Serbian laws with the EU legislation and global standards has been speeding up. This is confirmed by the EU Serbia 2016 progress report, despite differences in sub-sectors and the call for further improvements in the field of e-government and overall IT capacity.

In the field of information society, the Law on information security, which established competent authorities for information security and a national cyber emergency response team, was adopted in January 2017, as was the e-Government Strategy, tasking the Ministry of Public Administration and Local Self-Government with coordination of various ministries and other institutions at the central and local government levels in this area.

Doing business in telecommunications is better regulated than in the IT sector. However, the Law on electronic communications is yet to be adopted in line with the 2009 EU regulatory framework. Competitive safeguards have not yet been fully implemented. Serbia auctioned the 800 MHz radio-frequency band in November 2015, granting individual licenses to three mobile operators. Due to its size,

the telecommunications sector has attracted some of the major multinational companies, such as TELENOR and VIP, in the arena of mobile communications providers. At present, the state-owned telecommunication company, TELEKOM SRBIJA, which remains the major provider of landline telephony services, faces competition of private providers such as SBB.

The telecommunication sector is regulated by the Republic Telecommunications Agency (RATEL), an autonomous national regulatory body. RATEL has developed into a robust agency with a strong reputation among all actors in the sector. Since 2006, the RATEL has, on a regular basis, published annual overviews of the telecom market in Serbia - a very good source of information in this sector.

In 2013, Strategy for IT Industry Development and Support was adopted after a considerable amount of time and energy had been spent on it by stakeholders form IT business, education, civil, and public sectors, but without expected actions. One of the conclusions from the survey conducted among 200 leading software companies in Serbia at the beginning of 2013, was that "the special Government IT sector support program is necessary". The goal of the survey, as well as of the communication among a number of experts, was to propose measures that will intensify development of this sector and export potential to their fullest capacity. Although the strategic document came relatively soon after that, no actions have materialized yet.

There has been some progress in the digitization of public services for businesses and citizens, such as online applications for construction permits, submission of tax reports, and registration of new entrepreneurs. Even though startup community has become more vibrant, existing and would-be entrepreneurs are still facing many difficulties because of a weak eco-system of support to entrepreneurship. A new regulation was introduced to support startups with tax breaks and incentives for employment, but these regulations are plagued by over-bureaucratized procedures which make them less usable.

The Government's practice of introducing a majority of new laws via emergency procedures and without a public debate or consultation with businesses does not make it better. Half-way into 2018, we are still awaiting for the long-announced law on VC investments and crowdfunding. Non-transparent public procurement is still diverting local IT companies toward international markets, depriving local environment of their products and services.

In general, Serbian tax regime is conducive to business. Corporate profit tax (15%), VAT (20%), while salary tax, and social insurance contributions are at the competitive levels in Central and Eastern Europe. However, a lot more work needs to be invested into removing red tape and aligning fiscal policy with needs of businesses.

Government ICT Policy

The creation of the National ICT R&D policy framework started in 2005 and the relevant Government institutions were founded: National Council for Science and Technological Development (NC), Ministry of Telecommunication and Information Society (MoTIS), Republic Agency for Telecommunication (RATEL), while the Ministry of Science and Technical Development (MoSTD) and the National Information Technology and Internet Agency (NITIA) were transformed. However, progress of ICT R&D is slow in comparison to the great potential it possesses. The possible reasons might lie in frequent changes in the Government. In the 2005-2017 period, there were eight Governments – consequently, there were eight different ministers of science.

The major objection here is that Serbia continues with discontinuity of IT jurisdiction, and we are still waiting for a dedicated ministry.

MoSTD was abolished, which caused R&D jurisdiction to descend to a lower level. Due to the Government reconstruction in 2011, as a measure towards solving economic optimization, two ministries: MoTIS and MoSTD, as well as agency NITIA were abolished. The jurisdiction of the MoTIS has been transferred to the newly established Digital Agenda under the Ministry of Culture, Media, and Information Society, while the Ministry of Education and Science overtook the jurisdiction of MoSTD. These changes did not seem to be the best solution for the ICT, particularly because it is expected that the focus of the Government during their expanding mandate is far from the ICT. However, the changes continue. After the elections in 2014, the ICT jurisdictions were split among (1) Ministry of Education, Science and Technological Development (R&D component); (2) Ministry of Trade, Tourism, and Telecommunications (ICT component at the level of Assistant Minister for Information Society) and (3) Digital Agenda under the Ministry of Public Administration and Local Self-Government, which was in charge of the IT industry and strategic software development. Unfortunately, upon the transformation of the Digital Agenda into the Directorate for e-Government, this responsibility was abolished in 2014.

The major objection here is that Serbia continues with discontinuity of IT jurisdiction, and we are still waiting for a dedicated ministry.

Access to finance

Lending activity is picking up but needs to be managed carefully. The financial system is dominated by commercial banks, mostly foreign-owned, holding more than 90 % of all assets. State control of the key entities in banking and insurance remained unchanged. Commercial bank loans were broadly stagnant over the last few years at around 47 % of GDP but started to expand noticeably in 2016. Reduced interest rates and accelerating economic activity have been instrumental in reviving lending activity. Credit to households expanded steadily in the last few years and accelerated further in 2016. After a prolonged period of decline, lending to companies gained momentum as well. However, the credit expansion would need to be managed carefully in order to avoid excesses and accumulation of new vulnerabilities.

Considering the budding startup scene and the slow increase of presence of international VC and seed investors, the announced law on VC and crowdfunding investments may bring benefits to those who need access to more flexible financing.

Finance (Demand and Supply)

Some progress was made concerning support to SMEs and entrepreneurship but SMEs face a number of challenges, including an unpredictable business environment, a high level of parafiscal charges, and difficult and costly access to finance.

The expensive (conventional) capital market in Serbia is still a typical transition country capital market, and certainly still presents a general obstacle for Serbian companies in any sector. But there are clear and substantial signs of improvement.

Serbian ICT companies aiming at developing their own products are in constant need for seed, start-up, venture, and other capital in order to cover their specific financial needs at all stages of the business cycle. Here are some highlights:

- There's a growing ICT entrepreneurship and startup scene that creates a wealth of new business ideas.
- Once established and sufficient funds provided, it takes about 5-7 years to prepare a company for IPO.
- Depending on the complexity of the product, between 10 and 20 software developers and other staff are needed for development.
- Companies such as SCHNEIDER ELECTRIC DMS NS, A51, EIPIX and NORDEUS are successful examples of Serbian companies developing and internationalizing their own products.

We expect that the new legislation on alternative investment tools, already announced by the Government, will serve as the vessel for channeling private capital and significantly improve access to finance for entreprenerurs and startups in Serbia.

Assessment of the Serbian ICT Sector

IT Market and Industry Current Situation

IT market - What is on sale? Serbian IT market generated €467 million in 2017, which provides a yearly growth of 6.0%. However, the trends of the three main market segments deviate from this average. The biggest segment, PC Delivery, stood on decline by almost 5%. On the other hand, the solid market growth of IT Services and Package Software segment is estimated to be higher than 10%. Market growth is mostly based on the support to the existing business infrastructure valued at more than €1 billion.

IT Industry - Who sells? When it comes to IT industry, it is not possible to summarize the results using few statistical data. In general, IT industry is making bigger steps than the IT Market, but creates a wide range of differences among companies – from failures to extremely successful ones. Significant deviation from the average statistical value is a trait of weak markets, and the Serbian IT market stagnates in the aftermath of the global crisis.

Domestic IT industry comprised 2,048 active enterprises in 2016. 21,514 employees made some 1.4% of the total workforce in all enterprises and state-funded organizations in Serbia. Employment rose by 10% compared to the previous year, but exclusively due to employment increase in export-oriented IT companies. Further strong growth against the low baseline will contribute to

the growing importance of IT sector as the healthiest one in the Serbian economy.

In the past, the Serbian IT Market development was based mainly on entrepreneurship and individual energies and initiatives, which resulted in a solid number of successful IT companies. The best ones, such as DMS, ASSECO, SAGA, were recognized by foreign investors, and now have foreign ownership. The so-called "spontaneous" development has its advantages, such as resulting quality, but it also has its flaws – it is slow. It is indisputable that Serbia needs more intensive IT growth, but this growth depends on the large public tenders with the Government, big investments from the business sector, and the presence of global IT vendors. Due to its high impact, the following part is focused on the Government and its direct/indirect influence and the growing impact on the ICT in Serbia.

Further strong growth against the low baseline will contribute to the growing importance of IT sector as the healthiest one in the Serbian economy.

Trends and Potentials:
New IT Goals for the Period 2018-2023

The Serbian IT market can be summarized as a huge growth potential on a small base. The official start of negotiations in the EU accession process has undoubtedly had a big significance for Serbia, but it is even more significant to meet the standards that are expected in 35 chapters. It is important to stress that IT pervades all these areas and it is hardly possible to imagine functioning of a modern society without IT support in education, health, public, and all other sectors. In the similar manner, IT is connected to the several Government strategies: for information society, e-communications, science and research, and economic development.

For all these reasons, the Government's influence on the Serbian IT Market growth is going to be of crucial importance, raising the need for new ways of tracking it. We propose to set the new maximum value of IT market to €1 billion, as shown in Figure 2 below. Although this value may appear too high, multiple previous analyses have confirmed it to be of significance for the Serbian IT Market. On the one hand, it stands as a challenge and a psychological threshold. On the other, it represents the minimum of IT investment per capita of the EU10 countries at the time of their accession to the EU (2004). The figure of €1 billion market value gives €150 per capita – the exact desirable minimum amount of IT investment. Previous analyses have also confirmed the value of IT investment per capita to be a very good indicator for reaching EU standards.

Therefore, by placing the amount of €150 per capita as the initial goal[10], Serbia would be better prepared to reach the standards of a more significant development. At the same time, Serbia would move up to the higher category of neighboring EU countries, from Tier 6 to Tier 5 shown in Figure 1.

Figure 2 Trends and Potentials – New IT Goal for the Period 2018-2025
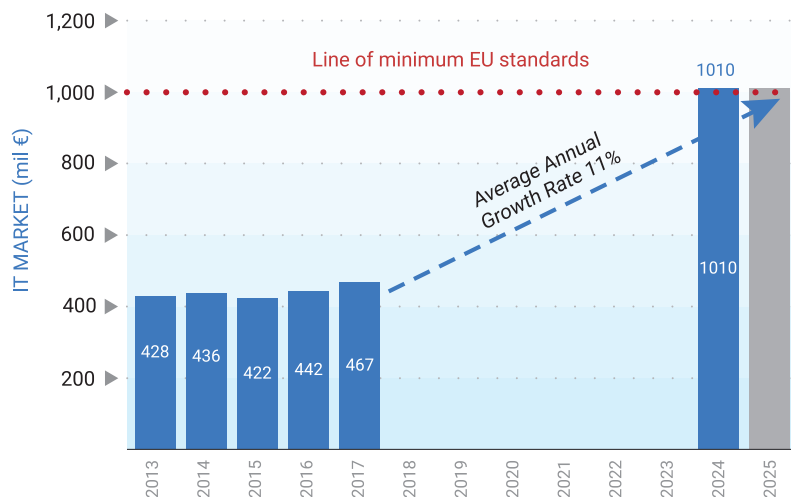
Source: SITO 2017

The current Serbian IT market is at the low level, and to plan the market value of €1 billion means setting the bar high. Besides raising the

awareness of how important it is to jump over this psychological barrier, another prerequisite for achieving this goal is the average annual GDP growth of more than 4%. In the current economic situation, this growing rate is practically impossible. However, Serbia has a chance to reach the projected €150 IT investments per capita by 2025, and bring the country to the threshold of EU standards. Certainly, IT also has to be at the top of the Government's priority list.

Government Initiatives and Influence on IT Market and IT Sector

At the time of publication of the previous edition of this study, Serbian Government has just started to pay attention to the fast development of IT sector. Much happened since then.

In June 2017, Ms. Ana Brnabić[11], until then the Minister for State Administration and Local Self-Government, received the mandate to form new Government. She devoted a significant part of the inauguration exposé to IT-related topics, and IT definitely became de facto mainstream in Serbian economy and public life.

What we still miss is the one place in the state administration to comprise and converge IT topics on the level of central government. In 2016, the Ministerial Council for Innovative Entrepreneurship and IT was established, which further sent a clear sign that Government

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10   This goal should, actually, be seen as the starting point of more significant economic development.

11   http://www.srbija.gov.rs/vlada/predsednik.php

intended to deal with the IT sector more in future. It is not a ministry, but can be seen as a step forward. Unfortunately, it seems that not many resources were put behind this body, and its performance might be limited. In October 2016, new Strategy of IT Development 2017 – 2020[12] was adopted, a document which covered almost all of the issues raised by the IT community. However, we had to wait for the follow-up Action Plan for Implementation of the Strategy of Development of the IT industry 2017 – 2020[13] more than a year, until December 2017, and it is a disappointing document. Some of the important issues were addressed only by noting that some analysis were planned, while there are no concrete actions in this Plan for most items from the Strategy.

At the end of 2017, Ministerial Council for Innovative Entrepreneurship and IT has published its Plan of Priority Goals and Activities of All Governmental Bodies and Services for Advancement of IT Sector in Serbia in 2018[14]. This document lists activities divided into four areas: IT Skills Development, Building Innovation Infrastructure, Legal Framework for Investors, and Competitive Market. The document seems to be well structured, but has some of the same flaws as the Action Plan above. In the area of IT Skills Development, it does not address one of the main obstacles for schooling more IT graduates at Serbian universities

– lack of high-quality teaching staff. In Building Innovation Infrastructure, it lists some old activities that are to be pushed forward, such as building ST parks – and that is excellent. It also lists some new ones, including mysterious "New building for education of IT engineers", without any details whatsoever as how construction of a building could solve the problem of lacking IT engineers. Lest we forget the existing PPP initiatives toward building innovation infrastructure in cooperation with companies and IT community, such as the BRAINS Center[15] in Novi Sad, which should have been included here. Instead, we list it here as another missed opportunity, waiting for better times. The Legal Framework for Investors area targets certain long awaited regulation, such as those on venture capital and crowdfunding – badly needed to improve startup environment. The area of Competitive Market addresses improvements for online business, but does not deal more actively with improvements in tax policies, or incentivizing businesses to adopt new technologies.

The IT community still debates if the Government's interest for IT is driven by the Government not being able to ignore the huge advancement of this sector anymore, or by the genuine good intentions. Too often, in their public appearances, random high-positioned government officials show little knowledge or understanding of the IT industry, its mechanisms and business models, needs and problems. For now, we hear a lot about good intentions, but need more actions. We propose that 2018 will be the tipping point.

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12 http://vojvodinaictcluster.org/strategija_industrija_informacione_tehnologije2017-20_018_cyr/
13 http://vojvodinaictcluster.org/strategija_it047_cyr/
14 http://vojvodinaictcluster.org/plan-prior-aktiv-saveta-za-ip-it-za-2018-271217/

15 http://vojvodinaictcluster.org/brains-center/

The Government has put IT high on its agenda, and that is the good news. There is more awareness about opportunities that this industry offers on different levels, and apparent willingness to try and take them toward betterment and long-term development of the economy, public services, and society in general. That is far more than what our IT community had few years back.

Nevertheless, we are still lacking a clear vision, sharp direction, and gritty and decisive actions without compromises. Strong cooperation among different ministries is still non-existent. Apprehension of corruption, especially in public procurement, is not dealt with. There are no attempts to make systemic changes, except for certain interventions in education. Our main message is that the bar has to be set significantly higher. IT community was heavily involved in drafting the Strategy in 2016, and the Government should enhance such cooperation with industry when planning and implementing measures in IT sector.[16]

Numerous tasks regarding IT stand before the Government, and the most important one is providing more IT skills on the labor market. IT skills are driving force of the entire IT development, and the Government is the major financier of almost all high education institutions. That is why investments in this area have to be as high as possible. In 2017, quotas for IT studies in public universities were raised by 17%, but raising quota alone will not solve the problem. Another issue is lack of teaching staff for IT, as it is far more lucrative (and easier) for them to land a job in private companies.

Brain-drain continues to be a big problem, albeit not sufficiently visible in public, and it needs to be dealt with.

We hope that the Government will find the strength in the forthcoming period to deal with the detailed statistical overview of the IT industry, and start a periodical publication of the key indicators as preconditions for determining technology development level, research & development potentials, and more clear strategy of IT development. Following up and analyzing the state of the IT infrastructure, usage, and influence of ICT on economy and society poses a chance to utilize a huge sleeping technological potential still existing in Serbia.

And last, but not the least, it is necessary for the Government to be continually engaged in decreasing the lagging behind the latest EU members. We need to eliminate the digital divide in Serbia, and create opportunities for everyone to take part in development processes, regardless of their geographical location or economic situation.

There is a difference between knowing the path, and walking the path.

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16 Such cooperation could help aovid set-backs and keep all key players on the same page (See: https://vojvodinaictcluster.org/taking-the-wrong-turn/)

ICT Market - Statistical Overview

This chapter provides basic information needed for an insight into the Serbian ICT sector, such as:

- Market value and structure
- Geographical market dispersion
- IT spending and investment in Serbia
- Usage of IT by households and businesses in Serbia

When measured according to the revenue per capita, the Serbian ICT market is lagging far more than according to the indicators of IT usage. The main reasons for this are:

- Buyers mostly focus on basic ICT solutions and low-end specifications;
- Buyers orientation on non-brand solutions is higher than on the A-brand ones;
- Low-prices of the ICT solutions are an imperative;
- The cost of local IT services and software is up to o 50% lower than the EU average for the same specifications/expertise;
- The replacement cycle is far longer than in EU countries (instead of 3-4 years, ICT solutions are replaced after 6-7 years and even longer).

IT Market Value and Structure

The estimated value of the domestic IT market is €467 million, which is the annual growth of 6%. We expect that equipment purchases will be at 2016 level, while software and IT services market value will probably have two-digit growth. We can observe this as an early indicator of a somewhat faster development of Serbian IT market, and start of tapping a large, yet unused potential. Unfavorable trend was present in the first half of 2017 only in the segment of PC market which continues to decline. If that decline gets terminated, it will be a confirmation of stronger recuperation of IT markets in the coming year. For the first time since 2008, and after 10 years

of stagnation, 2018 could be the year in which IT market value will surpass the psychological barrier of half a billion euros.

Figure 3 Serbian IT Market and Growth Rates for 2013-2017. (%)
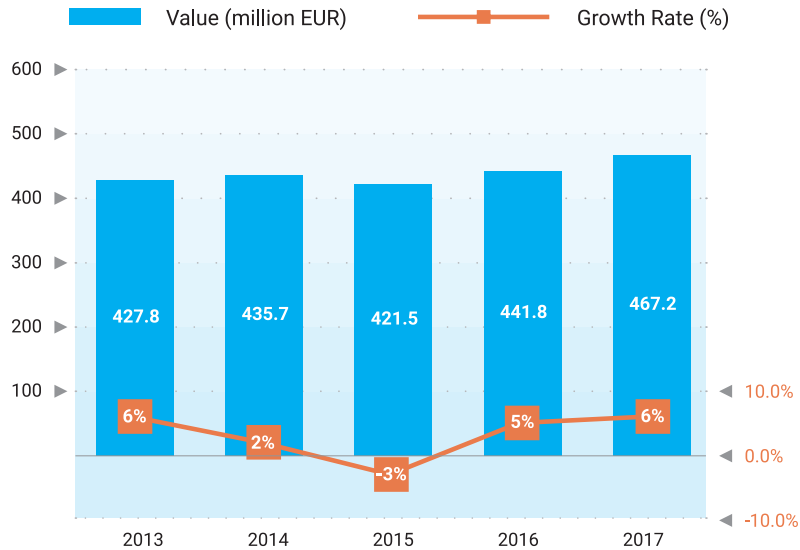
Source: SITO 2017

2018 could be the year in which IT market value will surpass the psychological barrier of half a billion euros

IT Market Structure

Figure 4: Serbian IT Market Structure vs. Profit in IT Sector in 2017.
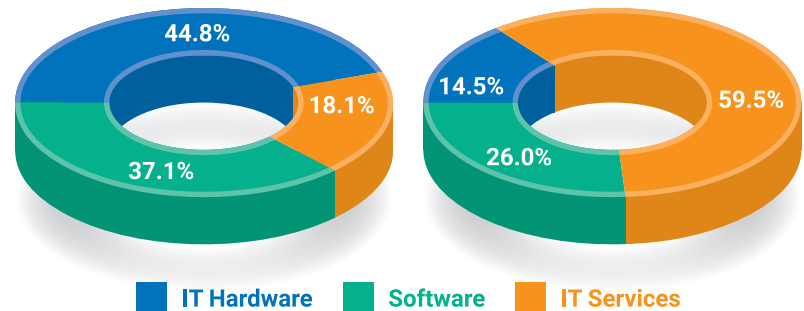
Source: SITO 2017

Key observations from the figure above:

- In the 2017 IT market structure, the segment of the IT Hardware with 44.8% share is still dominant, followed by IT Services segment with 37.1%, and the remaining 18.1% comes from Software. Such a market structure, according to European standards, clearly points to the market that is still not quite mature.
- Although IT Hardware still drives the IT market in Serbia, profit margins of hardware companies are extremely low, and consequently so is their profit. The highest available net profit, almost one half of the total IT industry net profit, is generated by the companies from the Software sector (59.5%).

IT Services Structure

Figure 5: Structure of IT Service in Serbia in 2017 and CAGR (5 year period)
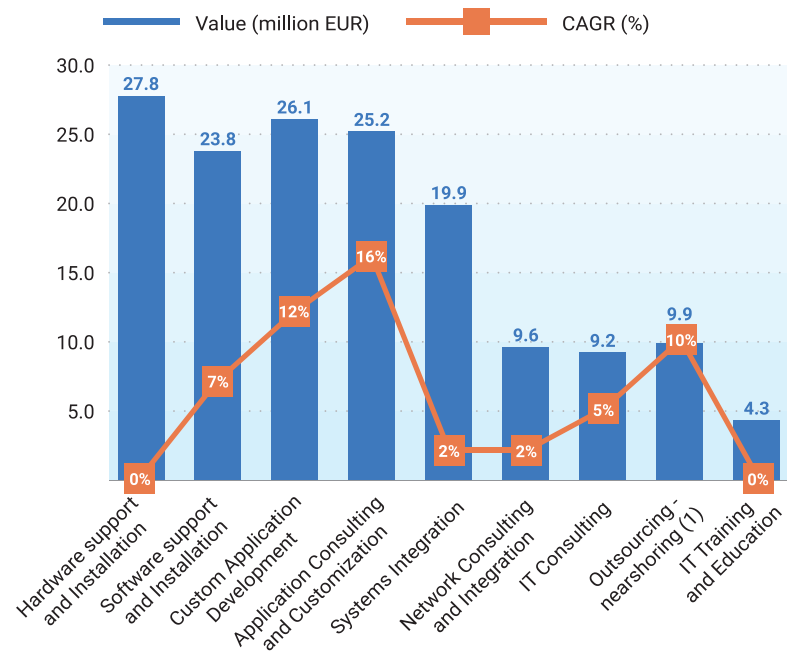
Source: SITO 2017

CAGR – [%] Compound Annual Growth Rate for the five year period (2013-2017)

While the hardware support and installation market will see a continued demand in the future, its share of the total services market is expected to contract.

The four major vertical markets: government, finance, manufacturing, and telecommunications are likely to be the largest spenders on IT services in Serbia in the coming years. As Serbia continues to stabilize both economically and politically, it has the potential to increase its FDI. As in other developing countries in the region, these four sectors have been the prime beneficiaries of the inflow of FDI, which has fostered spending on IT services.

A significant part of IT services is internal (end-user companies rely on their own IT departments). These services are not included in the analysis.

The strength and number of international vendors operating in the region and Serbia will increase and will have the following implications:

- As service engagements require more intricate and specific solutions, local service firms will have to form strategic partnerships with traditional product vendors or with international service companies, to meet customer needs.
- A number of local IT services companies are staffed with highly skilled employees and the acquisition of these companies can be a useful tool for international vendor entry into one of the IT markets, as it has already been seen all over the CEE region.

Application Software Structure

Figure 6: Software Market in Serbia 2014-2017
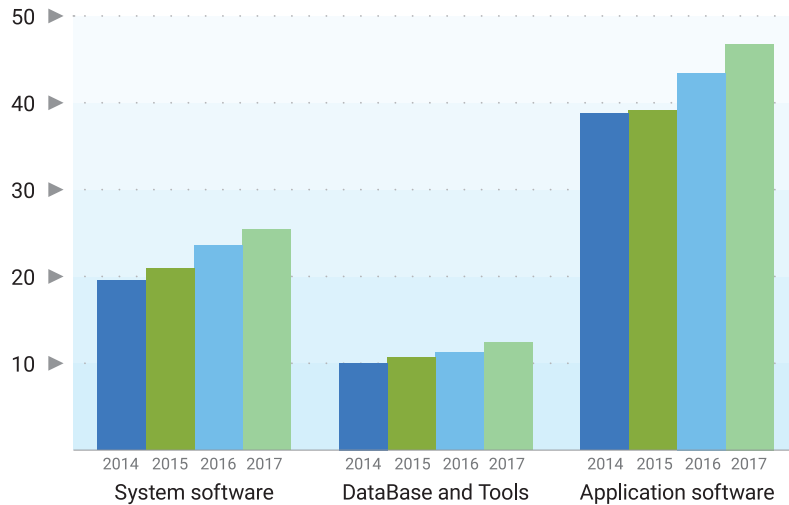
Source: SITO 2017

In 2017, the Serbian market for application software reached a value of €46.1 million. Business applications (ERP, SCM, and Accounting) make up the largest part, constituting 50.8%. Collaborative applications (DM, CMS, CRM, BI, Portal, and Web) follow with 28.1% of the market share.

Figure 7: Structure of Application Software Market in Serbia, 2017

- **Business Applications** (ERP, SCM, Accounting)
- **Collaborative Apps** (DM, CMS, CRM, BI, Portal, Web)
- **Other Business Apps** (eBus, Mobility, Office)
- **Engineering Applications**
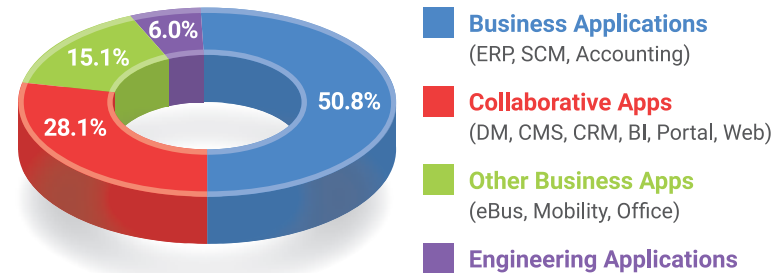
Source: SITO 2017

Local software producers dominate the Accounting and ERP market in Serbia, given their flexibility in developing custom software applications. Custom application development represents an option for a large number of companies (particularly SMEs) seeking a software solution.

Increasing demand for software applications – both ready-made and custom developed packages – will drive growth in this foundation market in the period 2018-2023.

IT Spending and Investments

One of the core potentials for Serbian IT companies remains to be the local market. The Serbian economy is still in transition, with outdated production lines that should be replaced with new technologies. IT solutions are also necessary for increasing efficiency in management.

IT companies in Serbia should invest more time in getting specific knowledge about the economy in Serbia, and by doing that to position themselves for future opportunities. Furthermore, IT companies should help the technologically outdated Serbian industry with solutions that might increase productivity, innovation, and competitiveness on the international and domestic markets. Good examples are domestic companies AB Soft, IIB, Digit and M&I Systems Co. as the leading ERP solution providers in Serbia, with excellent references and long tradition in business.

The research on the usage of PCs in Serbian companies shows that 100% of the companies use computers, regardless of their size, sector or geographic location. However, the percentage of employees who use computers in their everyday work is considerably lower in comparison to the EU member countries. Many companies know that digital transformation of businesses is well under way, but still have reservations. The effects of the explosion of IT innovations in developed economies only trickle towards individual cases of acceptance and application in Serbia. To be realistic, there are also big challenges as to what to use and to what extent.

Traditional IT is ever cheaper, but is also of ever better performances, which does not help growth of the IT market. Modern economy is based on continual growth, hence seeks new revenue sources. Since 2010, IT market finds salvation in the Third Platform (Social, Mobile, Cloud & Analytics, and IoT). Let us take a look at the state and usage of these solutions in our companies. IT infrastructure from providers and global IT players exceeds its usage by far. The share of the cloud market in the total IT market in Serbia is five times lower than the global average, and we should not seek comfort in the fact that there are many countries where situation is even worse. Similarly, mobile computing is still looking for its place in the Serbian market.

Internet of Things development is precondition for the introduction of "smart" environments. Smart cities, smart grids, smart houses and smart classrooms – are becoming the new reality. Thanks to a plunge in prices, different types of sensors and electronic devices have become accessible to millions of users. Several companies and institutes in Serbia are researching the best ideas for application, and achieving Europe-wide recognized results.

Business Analytics and Big Data comprise one of the most important pillars of future IT market growth. Practical advantages of analytical solutions for business are promoted, while confirmation of ownership of personal data becomes a global challenge that will stay with these business models.

Figure 8: IT Spending and Investments in Serbia, 2017
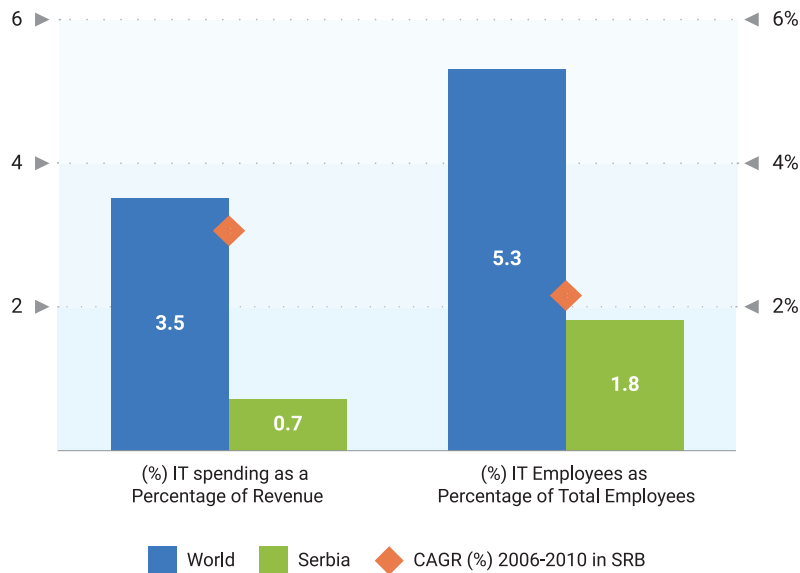
Source: SITO 2017, Gartner – IT Spending and Staffing Report 2008

- Serbian companies invest around 0.7% of their revenue in IT, which is significantly lower than the global average (3.5%). Taking into consideration that revenues of Serbian companies are low, the absolute amount of their IT spending looks even smaller.

- Similar situation can be seen with IT employment. The diagram above shows that Serbian companies employ 3 times less IT experts (1.8%) than their competition abroad (5.3%).
- The growth rate of IT investments (6%), as well as the growth rate of IT employment (4%) are above the world average. Identified gap could be closed, but it will require years at this rate.

Why IT Investments Particularly?

Investments are always important, especially in a crisis. Since the information technologies are at the base of every optimization, the crisis is the right time for strategic investments. The main reasons are:

- IT infrastructure is the important precondition for economic, societal and development of government;
- IT industry requires significantly less resources than other industries, which eases positioning in global economy;
- IT industry yields less costs, and more profits than most other industries;
- IT industry development prevents the "brain drain".

IT and Internet Usage

Since 2006, the Statistical Office of the Republic of Serbia is publishing statistics on the usage of ICT in households and businesses. The 2017 report showed that 68.1% of households had personal computers and 43.7% had laptop computers. The ownership of ICT equipment is mostly concentrated among the urban population with a monthly income of more than €600 (95.1%). The overall usage of computers in Serbia is still unsatisfactory, with 26.1% of the population having no access to computers. The number of PC users has increased by 1.1% in 2017. Among different groups within the population, students are most active in using computers (98.1%), followed by employees (86.6%). In real figures, more than 3.1 million people in Serbia use computers every day.

In Serbia, 68.0% of households have Internet access, which is by 3.3% more than in 2016. In Belgrade, 77.5% of households have the Internet, in Vojvodina 68.7%, and in Central Serbia 63.8%. A digital divide, both economical and geographical, is visible.

Total of 3.3 million people in Serbia use the Internet on a daily basis. Most of them use the Internet at home (92.5%). The survey estimates that more than 1,270,000 people use e-Government services in Serbia.

The majority of companies (99.7%) have access to the Internet, using mostly DSL (xDSL, ADSL) as a connection (51%). The majority of the companies that have an Internet connection use e-Government

Figure 9: Digital Divide. Households with Internet Connection, by Monthly Incomes Level
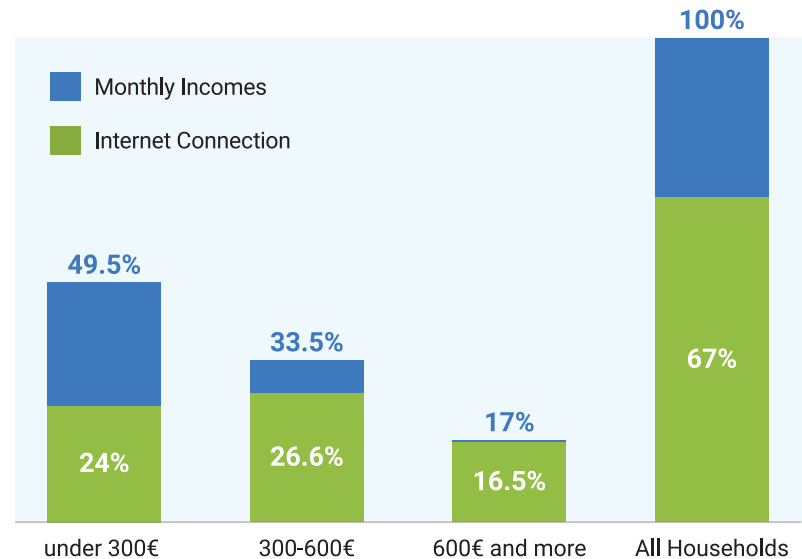
Source: Statistical Office of the Republic of Serbia 2017

services (94.5%). 80.4% of companies that have Internet connection have their own company website.

The survey also showed rather weak results in e-Commerce. Only 41.4% of the companies that have Internet access were engaged in purchasing goods/services online, and 23.8% of companies were approached through the Internet to deliver goods/services (0.5% more than in 2015).

Only 18.1% of Serbian companies use Enterprise Resource Planning (ERP), most of which are large companies (59.2%), then medium-sized companies (30.60%), and, finally, small companies (13.0%). Use of Customer Relationship Management (CRM) systems is at mere 12.8%.

The survey showed the usage of IT in Serbia is still in a developing phase. High penetration of IT into Serbian households and companies has been slowed down in the last two years. However, the main question is how much the ICT sector would be able to grow in the years of, and directly following, the recession. The Statistical Office data showed a great market potential in providing services in introducing IT solutions such as ERP and CRM. Website development also has market potential. Demand for delivery of hardware solutions continues to remain high.

Overview of the Telecommunication Market

According to RATEL's data, the revenues from telecom services in 2016 amounted to €1.54 billion. The average annual growth rate (CAGR) of the telecom sector revenues in the period from 2013 to 2016 was 1.0%. The share of telecom sector revenues in GDP was around 4.5% (cf. 5.7% in 2011). The total investments in the telecom sector in 2016 amounted to € 262.5 million.

In terms of different services, in 2016, the largest share in the total revenues, approximately 59.0% goes to the mobile market, whereas Media content Distribution with 9.7% represents the smallest share. Accordingly, investments in the mobile market have the largest share in the total revenues, 34.3% in 2016, whereas investments in CATV 26.9%. The structure of telecommunications sector revenues and investments is given below (Figure 10).

Figure 10 Revenue and Investments by Telecommunication Services, in 2017
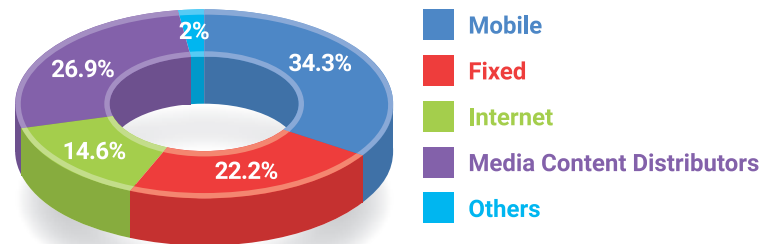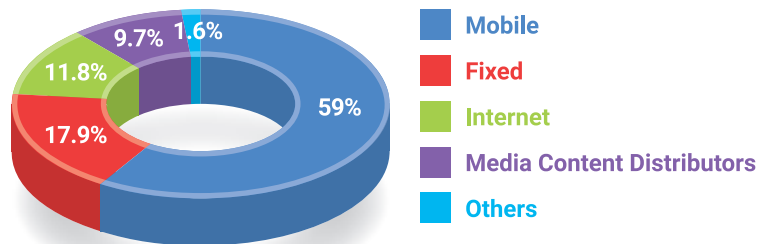
Source: RATEL [Republic Telecommunication Agency] 2017

Table 5: Total Number of Internet Operators in Serbia

Period	2011	2012	2013	2014	2014	2016
Number of operators	232	222	221	217	217	214

Source: RATEL [Republic Telecommunication Agency]

Serbian Internet Services Market

The total income earned from providing Internet services reached RSD 22.4 billion (around € 182 million) in 2016, which is the growth of 3% compared to 2015. The income was ten times multiplied in comparison to the year 2006 when the data were recorded for the first time.

Internet Operators. A total of 214 Internet operators were registered in Serbia by December 2016, approximately 10% lower than it had been in 2011.

Internet Penetration: In 2016, the number of broadband Internet connections per 100 citizens was approximately 75 and the number of fixed broadband Internet connections per 100 citizens approximately 20.

Broadband Internet Penetration: Unless 3G mobile network subscribers are taken into consideration, the penetration of fixed broadband Internet access amounts to 20%, which is above the average in the SEE region (15.0%). However, the penetration of broadband Internet access in Serbia is significantly below the EU27 average (28.8%).

Taking into consideration all relevant parameters, the Serbian Internet market projected constant growth in the coming years. It is expected that the number of broadband connections per 100 citizens will reach the level present in the developed European countries by 2025.

ICT Development Index

In 2007, the International Telecommunication Union (ITU) initiated the process of creating a single Index which could be utilized in measuring the development of the information society, the so called ICT Development Index (IDI). This single IDI serves as a benchmarking tool for measuring a) the development of the ICT market in UN Member States, b) digital divide between the developed and developing countries, and c) developmental potential of the ICT market.

This Index combines 11 indicators divided into three sub-groups: (1) ICT Readiness (infrastructure and access); (2) ICT use (primarily by individuals, but also households and businesses) and the intensity of use; (3) ICT Capability (skills necessary for the effective use of ICTs).

The value of IDI Index for the Republic of Serbia rose in 2016 to 6.87, which was an increase compared to 4.2 in 2008, 5.62 in 2012, 6.03 in 2013, 6.21 in 2014, and 6.76 in 2015. Considering the previous ITU data we may anticipate that, based on the IDI Index value, Serbia will secure a place among the first 50 countries in the list.

The fact that the Serbian ICT access indicators have higher values (0.78) than ICT use indicators (0.59) is quite apparent and serves as an illustration of the disparity between the existing telecommunications infrastructure capacity and the use of such capacity in terms of telecommunication services within such infrastructure in Serbia, as is the case with the use of broadband Internet services. ICT skills indicators (0.69) are of the appropriate value.

Figure 11: ICT Development Index, IDI Structure
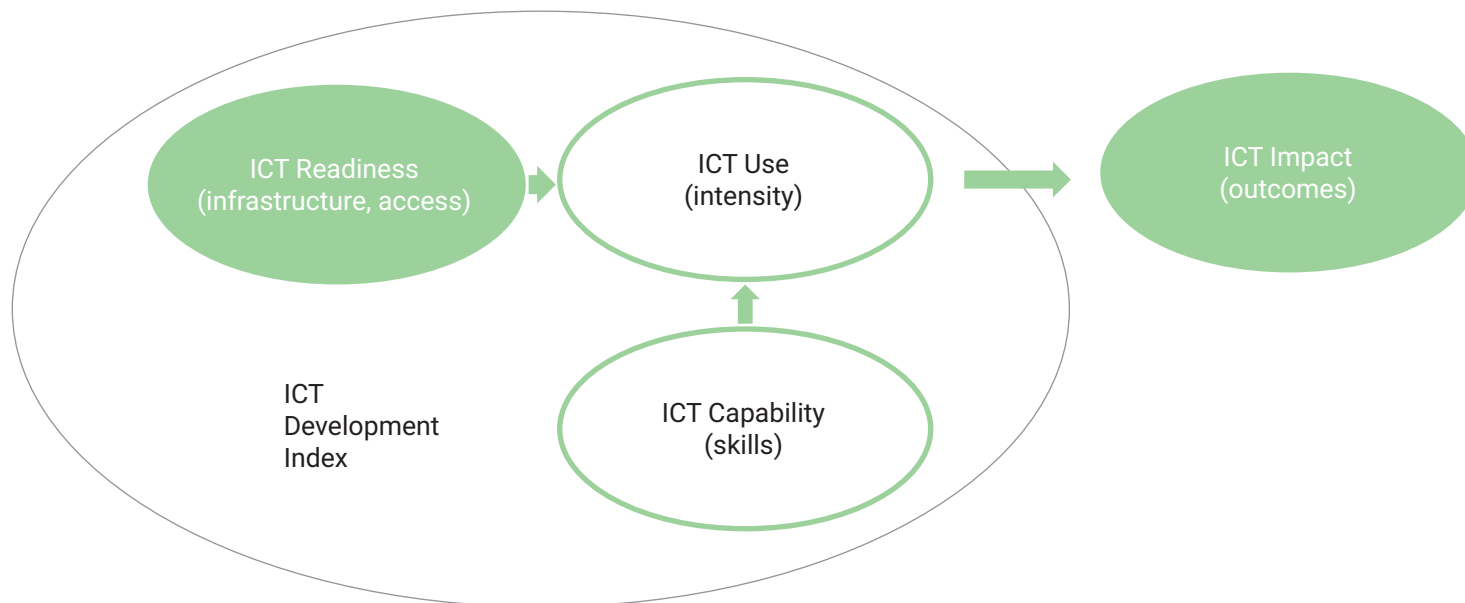
Source: RATEL [Republic Telecommunication Agency]

ICT Industry – Sector Analysis

This chapter provides basic information needed for an insight into the Serbian ICT Industry, such as:

- ICT sector definition and structure
- Number of companies, employees, revenue in IT industry and Software sub-sector
- IT Clusters and Support Organizations

ICT Industry Summary

ICT Sector Definition

For the needs of this report the 2007 OECD ICT sector definition (ISIC Rev. 4) is used.

Information technologies and Telecommunication in Serbia, as two separate segments of ICT industry, have different performances and trends: while IT is characterized as fragmented and liberal market with significant presence of SME segmentation, more mature telecommunication sector practically consists of three big mobile operators and one cable operator. The focus of this report is set to the SME segment and IT service companies, while Telecommunication is reduced to the few key observations.

In 2016, the total of 2,046 enterprises from the IT industry employed 21,514 employees, representing 1.4% of the Serbian workforce. Serbian TELCO industry comprised 250 enterprises with 18,842 employees, which made 1.1% of the total workforce in Serbia.

The difference in the average number of employees is noticeable: 11 in Serbian IT industry, and 75 in TELCO.

The total TELCO industry revenue is €2.2 billion, and €1.83 billion in the IT industry, while the average revenue per employee is €116,760 and €84,856, respectively.

For the purpose of this study, it is considered that only those companies whose real activity is within the above presented NACE classes

Table 6: OECD ICT Sector Definition

ICT manufacturing industries	IT	ICT industry Sector
2610 Manufacture of electronic components and boards	C	
2620 Manufacture of computers and peripheral equipment	Y	IT: PC Hardware
2630 Manufacture of communication equipment	C	Telco: Hardware
2640 Manufacture of consumer electronics	C	
2680 Manufacture of magnetic and optical media	C	
ICT software and services	**IT**	**ICT industry Sector**
4651 Wholesale of computers, computer peripheral equipment and software	Y	IT: Channels - Wholesale and retail
4652 Wholesale of electronic and telecommunications equipment and parts	C	Telco: Channels
5820 Software publishing	Y	IT: Software
61 Telecommunications	C	Telco: Carrier
62 Computer programming, consultancy and related activities	Y	IT: Services & Software
631 Data processing, hosting and related activities; Web portals	C	Telco: Internet
951 Repair of computers and communication equipment	Y	IT: services

Legend: Y – IT Industry C - IT Converged industry

Table 7: IT Industry vs. Telco Industry in Serbia, 2016. Key indicators.

	IT Industry	TELCO Industry
Number of companies	2,046	250
Workforce	21,514	18,842
Average number of employees	11	75
Revenue (€)	1.83 billion	2.20 billion
Revenue per employee (€)	84,856	116,760

Source: SITO 2017

comprise the IT industry. Since identifying those companies is not an easy task in Serbia, the excerpt from the study "Serbian IT Industry 2016", which treats this issue in detail, is used. In order to get the precise insight of the Serbian IT industry structure, IT companies are grouped into four clearly defined categories, relying at the same time on the NACE classes as presented in Table 8. Those categories are: (1) IT Channels - Wholesale and retail; (2) IT services; (3) Software, and (4) PC Hardware. All those companies which did not have a clear product portfolio and are micro companies according to number of employees, are put in the category "Other - Unclassified". This classification also includes companies noticeably dealing with information technologies but coming from the converging industries: telecommunication, office equipment, and consumer/home electronic. These companies are covered by the category "Converged industry".

The data for this report is based on the non-consolidated publicly available data of IT companies taken from their financial reports for 2016 at the Serbian Business Registers Agency (SBRA) – Register of Financial Statements and Solvency.

This report is focused on Software sub-sector and the presentation of Serbian Software sub-sector through the number of IT companies, their size, structure, and number of employees. The terms: revenue, added value, and net asset in the Serbian IT sector are used for the entire IT sector where all the active IT companies' revenues, added values, and net assets are summarized respectively [see Terminology].

IT Industry and Software sub-sector

In its study on Serbian IT industry, the SITO published that the IT industry is significantly more profitable than other industries. Profitability index of the IT sector per employee is 636% of the overall economy profitability index. Additionally, the sector needs for resources are significantly less than in other industries as the sector net assets per employee are close to 47% of the total economy net assets. Those IT sector features lead to the conclusion that one IT employee with half the average resources - makes profit 6 times bigger. In addition, the liquidity of IT companies is twice the economy average, while debt and bank loans are at the level of 47% of the economy average. Further, the SITO found that IT companies have the highest average gross wage - 150% higher than the Serbian aver-

age. Finally, IT industry development creates the preconditions for IT experts to stay in Serbia, instead of massively going abroad.

When it comes to **geographic distribution of ICT companies**, most companies in Serbia are located in Belgrade, Niš, and Novi Sad. The vast majority of other municipalities have an insignificant concentration of ICT companies.

The Serbian IT industry, in 2016, comprised 2,048 active companies, while their 21,514 employees represented 1.4% of the total workforce in all companies, including publicly financed organizations in Serbia. Employment rose by 10% comparing to the previous year, exclusively thank to the growth of export-oriented IT companies. Big growth on a small base will contribute to the growing importance of the IT sector as **the healthiest sector of the Serbian economy**.

Every year, 200 new IT companies are registered in Serbia. Majority of newly established companies employ programmers, and are oriented toward vital and liquid international IT market, while minority seeks their chances on the sleepy local market. We have said more than once that Serbia exports its workforce cheaply, while importing expensive tech solutions. The place of Serbia in the international proportions should be much higher. However, the question is if it is possible, because 9 out of 10 biggest IT exporters are owned by foreigners – who close their added value chain outside of Serbia.

The IT industry structure, according to the industry sub-sectors and enterprise distribution by company size, is presented in the table below.

Table 8: Number of IT companies in Serbia, 2016 by the IT Sub-sector and Company size

IT industry sub-sector	Micro Enterprises	Small Enterprises	Medium Enterprises	Large Enterprises	Total
IT Channels - Wholesale and retail	14	18	5	1	38
IT services	419	46	15	1	481
Software	937	254	41	6	1,238
PC Hardware	259	27	3	0	289
Total	1,629	345	64	8	2,046
Total [%]	79.6%	16.9%	3.1%	0.4%	100.0%

Figure 12: Distribution of IT Industry, by Sub-sectors

- IT Channels - Wholesale and retail
- IT Services
- Software
- PC Hardware
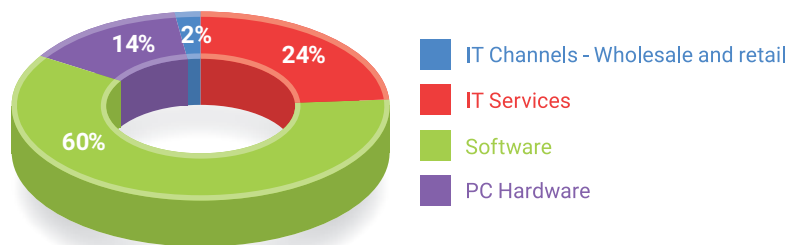
Source: SITO 2017

Key comments for the table above:

- In the Serbian IT industry there are only eight big IT enterprises (with more than 250 employees). Total number of SME enterprises is 409, which is 20.0% of all IT enterprises. This number is seen as an unfavorable indicator – the number of SMEs in this sub-sector should be significantly higher.
- About three quarters of enterprises from the SME segment are active in the Software sub-sector (295 of 409).
- A huge number of micro companies (1,629), with low financial capacities, insufficient technological and management skills, visibly characterize the Serbian IT industry.
- Investments and support to the SME segment are observed as decisive factor for the fast development of the IT industry.

Number of Software Sub-sector Companies in Serbia

In respect to company activity, the Software sub-sector dominates in the Serbian IT industry with 1,238 enterprises, which is 60% of the total number of enterprises in the IT industry. Investments and support to SME segment are necessary and pivotal factors for the fast IT industry development.

Figure 13: Distribution of Software sub-sector by segments, 2016

- 25% Software Exporter
- 11% ERP Specialist
- 64% Other Software

Source: SITO 2017

Enterprise distribution according to their size and Software segment is presented in the table below. The key sub-groups: (a) software exporters are companies that generate majority of their income through software export, (b) ERP solution providers are active on the local market only, (c) others – all other software companies. This segmentation reflects particularities of the Serbian software sector well.
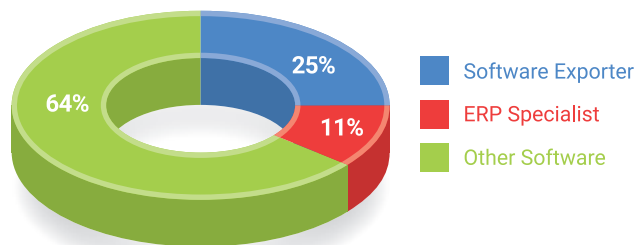
Key comments for table 9:

- In the Serbian Software sub-sector, there are only six big IT enterprises (with more than 250 employees). The total number of SME enterprises is 295, which is 23.8% of the total enterprise number in the Software sub-sector. The number of the SMEs in this sub-sector should be significantly higher.

Table 9: Number of Software sub-sector by the segment and Company size, 2016

Software segment	Micro Enterprises	Small Enterprises	Medium Enterprises	Large Enterprises	Total
Software Exporter	120	142	36	6	304
ERP Specialist	84	54	4	0	142
Other Software	733	58	1	0	792
Total	937	254	41	6	1,238
Total [%]	75.7%	20.5%	3.3%	0.5%	100.0%

- A large number of micro companies (937), which have low financial capacities, insufficient technological and management skills, visibly characterize the Serbian Software sub-sector. The situation is further exacerbated due to the significant number of Software enterprises in the category "Other Software" with 792 enterprises of which 733 are micro enterprises.
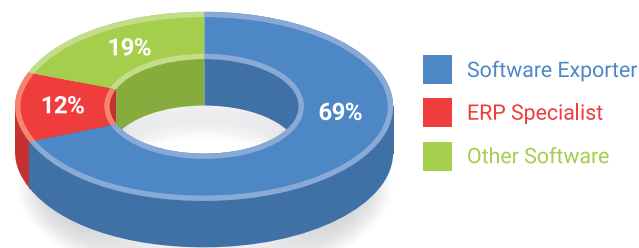
Workforce in the Serbian Software Sub-Sector

Serbian IT industry employed 21,514 people in 2016, which makes only a fraction of the total workforce of 1.45 million (without entrepreneurs). Compared to 2007 (the year before crisis), all IT sub-sectors increased the number of employees, which confirmed a developing character of the sector. Serbian ICT workforce is estimated at nearly 50,000 specialists. This estimate is based on the fact that, besides the IT industry, nearly 35,000 ICT specialists work in the telecommunication sector, end-user companies (companies which are IT users), and as entrepreneurs in the ICT sector.

Workforce in the software sub-sector according to the segments and company size is presented in the table below.

Figure 14: Software segments Share (%) in Total Number of Employees in Software sub-sector, 2016

Source: SITO 2017

Table 10: Workforce in Software sub-sector by segments and Company Size, 2016

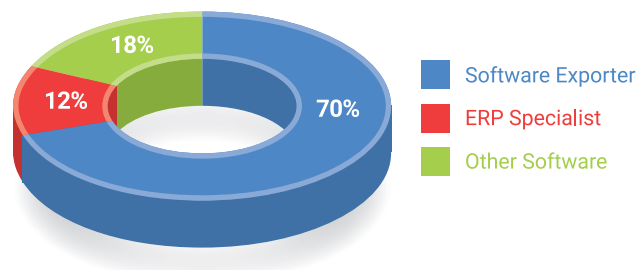| Software segment	Micro Enterprises	Small Enterprises	Medium Enterprises	Large Enterprises	Total
Software Exporter	515	3,338	3,538	2,677	10,068
ERP Specialist	372	1,070	278	0	1,720
Other Software	1,898	881	67	0	2,846
Total	2,785	5,289	3,883	2,677	14,634
Total [%]	19.0%	36.1%	26.5%	18.3%	100.0%

Key comments for table 10:

- The employment in the Software sub-sector increased significantly and above average in 2016, achieving 14,634 employees, or 68% of total IT sector workforce.
- The largest number of employees 10,068 (69%) is in the "Software exporter" segment, followed by the "Other Software" with 2,846 employees, or 19%. The lowest number of employees is in the "ERP Specialist" segment (12%). However, this distribution is expected to change, due to the Software sub-sector expansion and growing importance of large and medium enterprises.
- The SME segment in Software sub-sector records significant number of employees (9,172), which is 62.6% of the Software sub-sector segment workforce. Average number of employees in Software SME segment is 31, more than 2.5 times bigger than IT industry average (12).

Revenue in the Serbian Software Sub-Sector

Revenue of the IT industry represents the revenue of the whole IT sector - all IT companies revenues summarized. Compared to the value of the IT market, the IT industry revenue is typically three times higher, due to selling multiplications in distribution channel, export, and non-IT revenues of companies' business.

Figure 15: Revenue Structure of Software Sub-Sector (%), 2016

- Software Exporter
- ERP Specialist
- Other Software

Source: SITO 2017

Table 11: Revenue in Software sub-sector [€ million], by segments and Company Size, 2016

Software segment	Micro Enterprises	Small Enterprises	Medium Enterprises	Large Enterprises	Total
Software Exporter	46.9	114.3	136.5	87.3	384.9
ERP Specialist	15.6	38.6	14.0	0.0	68.2
Other Software	66.1	28.9	2.5	0.0	97.6
Total	128.6	181.8	153.0	87.3	550.7
Total [%]	23.3%	33.0%	27.8%	15.8%	100.0%

The Serbian IT Industry generated the total revenue of more than €1.8 billion in 2016. Based on the previous researches, it is estimated that the revenue from the IT hardware, software, and services make around 75% of the IT industry revenue (nearly €1.3 billion), while the remaining 25% came from converging and non- ICT products.

The highest revenue, 35% of it, was generated in the Wholesale and Retail sub-sector (€638.8 million). It is followed by Software sub-sector with €550.7 million (30%) which is similar to the IT Service sub-sector with €506.7 million (28%).

Distribution of the Software sub-sector revenue is in the Table 11.

Key comments for the table above:

- In comparison to 2015, Serbian total Software sub-sector revenue in 2016 grew by 29%, which is twice more than the entire IT market growth. The credit for this growth goes to the "Software exporter" segment.
- The highest revenue, 70% Software sub-sector revenue, was generated in the "Software exporter" segment (€384.9 million). It is followed by the "Other Software" segment with €97.6 million (18%).
- With a revenue of almost €330 million, the SME segment is at 60% share in the total Software sub-sector revenue. Within the SME segment, the biggest portion came from the "Software exporter" – more than 80%.
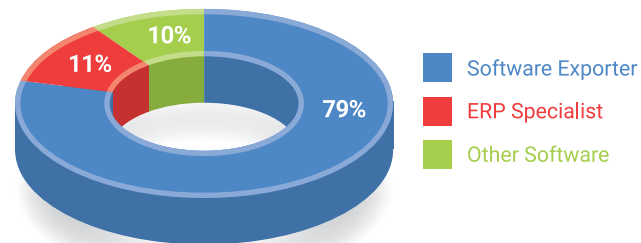
Net Assets of the Serbian Software Sub-Sector

Despite the crisis, the net assets of the Serbian IT industry continued to grow in 2016 and achieved around €504 million. Compared to 2006, where the IT industry net assets were around €150 million, the impressive compound annual growth rate (CAGR) of more than 15% was generated. This trend is the moving force for the private sector, which is dominant in the IT industry. The high return rates on net assets will certainly attract foreign investors willing to take the risk and seize the opportunity for a good profit. It is certain that IT sub-sectors – IT services and Software – are seen to have sound perspective.

The biggest net assets, over €267 million, which is almost 53% of the total IT industry net assets, are held by the companies in the Software sub-sector, followed by the IT Service (29%).

Distribution of the net assets in the Software sub-sector according to software segment and company size is in the Table 12.

Figure 16: Structure of Software Sub-sector (%) in Net Assets, 2016

- Software Exporter
- ERP Specialist
- Other Software

Source: SITO 2017

Table 12: Net Assets of Software sub-sector [€ million], 2016.

Software segment	Micro Enterprises	Small Enterprises	Medium Enterprises	Large Enterprises	Total
Software Exporter	32.6	54.8	53.6	70.8	211.8
ERP Specialist	5.0	18.6	5.8	0.0	29.4
Other Software	19.4	6.0	0.2	0.0	25.6
Total	56.9	79.4	59.6	70.8	266.8
Total [%]	21.3%	29.8%	22.3%	26.6%	100.0%

Key comments for table 12:

- The biggest net assets, around €212 million and almost 79% of the total Software sub-sector net assets, were held by the companies in the "Software Exporter" segment.
- With €140 million, the SME share was 52% in the Software sub-sector net assets in 2016.

Salary in the Serbian Software Sub-Sector

The average gross salary span by companies' specialty is from €1,024 for distributors to €1,792 for system integrators. Average gross salary in the software sub-sector is €1,450, which is similar to the rest of the IT sector (€1,433). Salary ranges within the category and within the companies are even greater, which depends on the experience and expertise of the individual employee. Average gross salaries in Software sub-sector are presented in the Table 13.
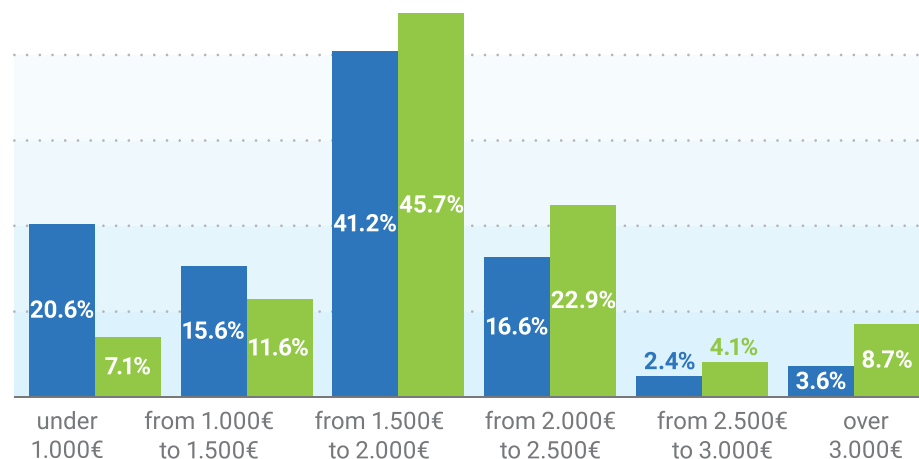
Key comments for table 13:

- Analysis includes 14,634 employees in the Software sub-sector, which is 68% of the total IT sector workforce.
- Software exporting companies employ 10,068 workers, which is approximately 47% of the total IT workforce in Serbia, while

Table 13: Salary in Software sub-sector by segments and Company Size, 2016

Software segment	Micro Enterprises	Small Enterprises	Medium Enterprises	Large Enterprises	Total
Software Exporter	1,405	1,459	1,953	1,708	1,696
ERP Specialist	806	1,105	1,805		1,153
Other Software	712	858	659		756
Total	853	1,288	1,920	1,708	1,450
Total [%]	58.8%	88.8%	132.5%	117.8%	100.0%

the gross fund for exporters' salaries is €205 million or 55% of the total fund for salaries.

- The average salary in outsourcing companies is €1,696, which is higher than the sub-sector average that has reached €1,450.
- The largest portion of average salaries (45.7% of the total) is within €1,500 to €2,000 range. If we look at the ownership, salaries make up a major part of the total revenues with the companies where founders were international (typically, more than 70%), unlike local founders where this figure is less than 40%. International founders keep their daughter companies in Serbia on budgets dominated by the salaries percentage.

Figure 17: Distrubution of workforce and gross salaries fund, according to ranges of average salaries, 2016

	under 1.000€	from 1.000€ to 1.500€	from 1.500€ to 2.000€	from 2.000€ to 2.500€	from 2.500€ to 3.000€	over 3.000€
blue	20.6%	15.6%	41.2%	16.6%	2.4%	3.6%
green	7.1%	11.6%	45.7%	22.9%	4.1%	8.7%

Source: SITO 2017

ICT Clusters and Support Organizations

Serbian IT companies have established a strong presence on foreign markets through successful marketing of their own solutions, but also by being able to provide the highest quality outsourcing services and creating solid partnerships. Thus, Serbia has emerged as a very interesting alternative location for the development of sophisticated software: an hour or two by plane from major European locations, harboring educated and experienced IT workforce, and delivering world-class quality while still keeping it all at a fraction of the costs in the West – no wonder the percentage of year on year growth in turnover for the past 8 years was in high 20s or low 30s.

Setting up clusters helped companies accelerate networking and reap benefits of joint activities. These clusters and associations give necessary institutional support to performances of the Serbian IT industry and make their members visible internationally in a more structured way.

Vojvodina ICT Cluster – VOICT

Vojvodina ICT Cluster - VOICT provides a single point of contact with the best IT companies in Serbia, employing 4,000+ experienced IT professionals. VOICT builds long-term relationships based on trust and quality, bringing expertise, experience, and excellence to each and every project. It is a fast-growing association, leading the way for similar organizations in Serbia.

9 out of 10 VOICT members do business on foreign markets –

mostly EU, North America, and the Middle East. The companies from this cluster exhibited strong growth in recent years, even during and after the global recession. VOICT is giving institutional support to this trend, mobilizing players from other domains, such as education, and government, weaving the network of support. Thanks to the University of Novi Sad, and especially the Faculty of Technical Sciences, innovation and entrepreneurship have been fueled for many years. Today, Novi Sad is the center for IT in Serbia. The vision of Vojvodina ICT Cluster is Digital Serbia, a country powered by knowledge, utilizing accumulated IT expertise. Strategic objective of VOICT is to mobilize players from the business, education and government around activities that bring this vision closer to reality.

VOICT is constantly building an ever stronger network of international contacts, creating new business opportunities for its members, lobbying for improvement of business environment in Serbia and popularization of IT solutions and products, enabling more intensive penetration of these technologies throughout other sectors of the Serbian economy.

The cluster has its own Cluster Academy, organizing courses, presentations, and workshops according to the needs of the members, as well as a separate Project Office that grows its projects portfolio and revenues every year, making Vojvodina ICT Cluster a leader in excellence among organizations of this type in Serbia.

More at www.vojvodinaICTcluster.org

ICT Network Serbia Cluster – ICT Net

ICT Network is an association of companies, individuals, academic and research institutions devoted to the development of the ICT sector in Serbia. It was established in 2010 after the merger of two former cluster initiatives, Serbian Software Cluster and Embedded. rs. As a unique information hub, today, ICT Network provides its members with access to relevant and up-to-date information from the ICT industry, thus enabling them to boost their competitiveness and grow. As an open organization, it offers its members equality of opportunities and a transparent framework for efficient fulfillment of their interests.

One of the Cluster's main objectives is to encourage its members to suggest their own initiatives or projects which can be implemented either through the Cluster's extensive network of strategic partnerships or in cooperation with other member companies. It provides its members with a variety of opportunities helping them to build greater visibility while keeping their business operations cost and time effective. Currently, the Cluster is focused on obtaining easier access to public and EU funds for its members, giving them a possibility to internationalize business operations and actively support their innovative and enterprising initiatives and projects.

More at www.ict-net.com

Niš Cluster of Advanced Technologies - Ni CAT

The NiCAT is a cluster initiative that comprises 24 local companies, two scientific research institutions (Faculty of Electronic Engineering and Faculty of Mechanical Engineering - University of Niš), and three economic development support institutions (Regional Development Agency RDA South, Regional Chamber of Commerce and Business Incubator Niš). The Cluster represents companies from five different industries which include electro medicine, electronics and automation, electronics and mechanical engineering, ICT and optoelectronics.

The Niš Cluster of Advanced Technologies was formally registered in March 2011 and started its full operational work in October 2011. NiCAT cluster actively works on building the entrepreneurial ecosystem and has continuously recorded success. Its members employ about 700 people and reached a combined annual turnover of EUR 17 million in 2014. The Cluster's goals are to increase the turnover of the cluster members both on national and international markets; strengthen the capacities of the companies for technological development and innovations, and to develop new technological products and services. The promotion of the City of Niš as a favorable location for business operations in the advanced technology field is a strategic focus. In a relatively short period of time, the Niš Cluster of Advanced Technologies has implemented a number of things and has established partnerships with important national and international institutions. NiCAT is one of the six best clusters in Serbia.

More at www.ni-cat.org

ICT Cluster of Central Serbia- ICT CS

The business association ICT Cluster of Central Serbia, Kragujevac, has been established as a response on initiative of the Central Serbia IT companies. It aims to increase their visibility on global markets, and improve business operations through joint action. Founded in May 2013, this organization comprises 23 members – 13 companies form IT industry, plus educational institutions, consultant organizations, and a business incubator.

Working for development of IT industry and community in the Central Serbia, the cluster is active in various fields: creating better-qualified workforce through coding courses (both commercial and within projects), increasing visibility and creating potential for collaboration of its members as a part of domestic and international consortia and associations, organizing HR workshops, events and supporting initiatives which help promotion of potentials of IT sector in Central Serbia and in Serbia in general.

More at http://ict-cs.org

IT Cluster Subotica

IT Cluster Subotica was founded to bring together local IT companies or IT companies nearby that have intentions to work on the territory of Subotica. The aim of the Cluster is to promote the quality of life, better communication between local authorities and members of the cluster.

Another task is to raise awareness of the importance of good communication and cooperation between different companies and institutions that depend on new technologies. These will contribute to the progress of the association, reduction of operational costs and to the profit increase for some companies.

The Cluster provides opportunities for young people to stay in their hometown, to work, make progress, and have a competitive salary.

IT Cluster Subotica strives to create connections between companies, local authorities, people, knowledge, and technologies – to bring about realization of their common goals.

More at www.itcsubotica.org.rs

Zrenjanin ICT Cluster

Zrenjanin ICT Cluster was established in 2016 by an informal working group comprising local organizations interested in the development of information and communication technologies sector in Zrenjanin: educational institutions schooling future IT professionals, IT companies, business community associations, and representatives of the local government, the City of Zrenjanin. The working group was formed at the initiative of the Zrenjanin Business Circle (Association ZREPOK) with the idea to launch an action that would result in greater involvement of Zrenjanin and the Central Banat Region in the development of the ICT sector in Serbia, and significantly better exploitation of the potentials that Zrenjanin and this region have in terms of opportunities offered by this dynamic business sector.

The founders of the Zrenjanin ICT cluster are convinced that the city of Zrenjanin has exceptional opportunities to develop this area, to be recognized as one of the five most important IT centers in Serbia, and that it will provide excellent conditions for education and work of IT professionals and business.

More at http://www.zrict.rs

South-Eastern Europe ICT - SEE ICT

SEE ICT is a non-profit association established in 2010, which runs a network of 8 hubs and co-working spaces, Startit Centers, across the country which are hosting more than 500 events annually and attract 24,000 people. The organization also manages the leading local tech and entrepreneurship media[17,] which is read by 70,000 people every month.

The mission of the organization is to reduce the brain drain in the country by providing meaningful, deep support to Serbian young people and entrepreneurs, improving life and work with technology. SEE ICT develops various programs to support the growth of the local tech community — from providing additional informal education to both tech professionals and beginners, through startup incubation to helping SMEs and big companies to address digital transformation.

More at http://seeict.org

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17   https://startit.rs/

BioSense Institute

BioSense Institute coordinates, focuses and advances research, introduction and promotion of state-of-the-art ICT solutions in agriculture, ecology, environmental protection, water management and industry. BioSense Institute is an internationally recognized multi-disciplinary scientific research institute and a regional provider of advanced information and communication technologies (ICT) in agriculture and environmental monitoring. In the BioSense Institute, recognized by EC as a "scientific lighthouse in the region" and thus financed for further reinforcement of Institute itself and its infrastructures, novel scientific concepts such as "smart dust", "crowdsourcing", "compressed sensing", "digital fountain" and "open innovation" are not only becoming a reality but are also put in action in various mission-critical real life cases.

The Institute's specific strength is their well-developed community of innovative start-ups and companies from the agricultural ecosystem and a pool of engaged householders, as it is a home for the first European Living Lab, focused on Precision Agriculture (PA4ALL). Because of its ability to bring together state decision-makers, ICT community and agricultural producers, BioSense has a broad overview of the overall rural value chain.

More at http://biosens.rs

Serbian Chamber of Commerce

The Chamber of Commerce and Industry of Serbia serves as a good role model in mobilizing and networking ICT sector companies and professionals. It is an independent, modern and responsible non-budgetary institution, a national association of all Serbian businesspeople, which serves the best interests of its members and the Serbian economy, owing to its tradition, experience and knowledge. The Chamber`s Association of Electronic Communications and Information Society and its groups: group of manufacturers of computers and IT equipment; group of software manufacturers and group for e-commerce, gather all Serbian IT companies. The key commitment of the Chamber is to make Serbia visible as a market economy country, with investment opportunities, open borders, and ready to join the European trends in a competitive way.

The focus of the Chamber`s Association of Electronic Communications and Information Society is on the Digital Single Market of the Western Balkan. The Chamber has good communication lines and a potential for policy advocacy, recognized by ICT companies. In cooperation with line ministries, Development Agency of Serbia, clusters and business and professional organizations, the Chamber is active in organizing conferences, forums, international and domestic fairs and other events that serve the purpose of development in the ICT sector. The Chamber is also active in organizing B2B events, networking Serbian ICT companies with their peers from many countries, like Germany, Austria, etc. Find more at www.pks.rs

Digital Serbia Initiative - DSI

Digital Serbia Initiative is a private non-profit organization which aims at building and strengthening all parts of a successful digital and high-tech innovation ecosystem in Serbia. The organization aims to create an environment in which Serbian tech companies, each in their field, will become European leaders and all citizens will be able to reach their full potential.

Nine founding companies (Infostud, Nordeus, Microsoft, PwC, Ringier Axel Springer, StartIt, Seven Bridges, Telekom Srbija and Telenor) and other members invest their knowledge, experience, resources, leaders' motivation and network of contacts enabling Digital Serbia Initiative to act as an agent of change in the Fourth Industrial Revolution in Serbia.

More at http://www.dsi.rs

Joint Cluster Initiatives

The number of IT clusters in Serbia has grown to six, and the two youngest clusters have joined the existing Strategic Partnership Agreement. This partnership is growing into a platform for the development of joint activities and coordinated efforts, which include establishment of the Serbian Cluster Association - SCAN[18]. This strategic alliance also forms the basis for advocacy initiatives on industry-specific issues on a broad range of topics like education and the improvement of business environment.

These activities include the Serbian-German IT Business Dialogue which was initiated with the help of the Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, as well as Scandinavia IT Business Bridge initiative, started in 2015 and helped by USAID REG project. These initiatives provide an open framework which brings together major Serbian stakeholders with private and public sector stakeholders from the ICT industry in Germany, Austria, Switzerland, Sweden, Norway, Denmark, and Finland, such as clusters, associations, investment and export agencies, relevant ministries, chambers of commerce, NGOs, R&Ds, etc. The objectives of this framework include increasing market knowledge, new business opportunities, stakeholder coordination and cooperation, organization of joint B2B events, and development of joint (EU) projects.

Serbian IT clusters were among founders of the Balkan & Black Sea ICT Cluster Network[19], a transnational organization whose task is to strengthen collaboration between IT cluster initiatives in the Region, and boost competitiveness of their members on the global market by means of specific actions and projects.

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18 http://www.aska.org.rs

19 www.bbs-ict.com

Education and Human Resource Development

This chapter provides the following information:

- An overview of ICT labor market in Serbia
- ICT and higher education in Serbia
- Cooperation between Universities and the Private Sector
- ICT and vocational trainings

The worsening demographic situation and weak education outcomes demand increased focus on human capital policies. Serbia's population is ageing and shrinking by around 0.5 % per year. Public spending on education is comparable to that of EU countries, but outcomes in terms of skills and key competences are weaker.

According to the Serbian Republic Statistical Agency (Chapter Education), in 2015/16, 98.6% of the pertinent population participated in primary education level, 89.6% in secondary, and 50.7% in tertiary education level.

The number of students in tertiary education increased by 2.7% in 2015/2016 academic year. The coverage of generation attending faculties and higher schools is about 50.7%, showing further tendency of slight increase.

In 2015/2016 school year, 19,285 out of 251,162 students are in the ICT area. Further 45,298 students are in the technical areas (engineering, manufacturing, and construction). The number of students associated with technical skills is rising year by year.

The quality, equality, and relevance of education and training have to be improved in order to better match societal needs. Both employers and graduates believe that the education institutions should improve in providing students with key soft skills, such as problem solving, organizational skills and decision-making. The national strategy and action plan for education development aims to address the outdated curricula and obsolete teaching methods. On the basis of existing qualification frameworks for vocational and higher education, an integrated national qualification framework for lifelong learning has been developed and is being consulted about with relevant national bodies. It should be linked with steps for a progressive reform of the education system at all levels, improving the level of basic skills acquired by students.

Overview of the ICT Labor Market

Total number of graduates in ICT and other technical areas is 11,666 which is 22.6% of all graduate students in 2016 (51,596). Besides this number, 2,078 more graduates come from natural sciences and mathematics. In general sense, all these graduates can be significant for the ICT sector.

In 2016, 5,244 ICT experts have graduated; 3,398 at the first level degree (B.Sc.), 1,453 at the second level (M.Sc.), 180 at the third level degree (Ph.D.). There are additional 213 Ph.D graduates who had enrolled programs prior to introduction of the Bologna reforms in Serbia.

Figure 18: Number of Students (vocational and academic) with ICT Titles, in 2016/2017
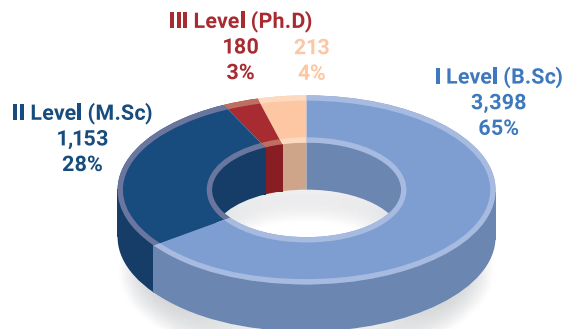
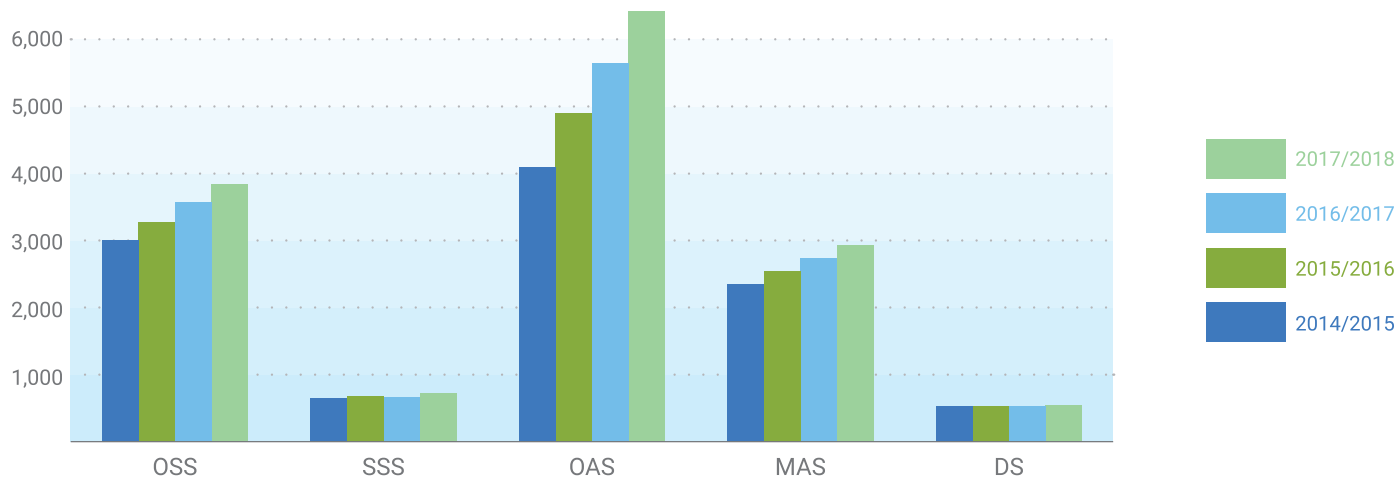*Source: SITO 2017*

ICT and Higher Education

The tradition of training personnel in electrical engineering in Serbia is over one century long. The need for staff qualified in informatics was recognized in 1980s within the Faculty of Electrical Engineering, Faculty of Mathematics, and Faculty of Organizational Sciences, in Belgrade; Electronic Faculty in Niš; Faculty of Technical Science and Faculty for Natural and Mathematical Sciences, in Novi Sad. With around 1,300 graduated IT experts annually, the above-mentioned Faculties make the backbone of Serbian high education (Tertiary-type A) in the IT area, as well as the base for research and development in this area. There is almost the same number of IT experts, graduating from other departments, with skills related to informatics. Tertiary-type A education is of strategic importance for ICT industry developing capacities.

ICT education exists at 51 high education institutions distributed in 23 cities, which helps recruiting a wide base of ICT students.

The Serbian ICT sector absorbs the vast majority of ICT graduates. This has not always been the case, as Serbia has been facing a massive "brain drain" of ICT graduates and professionals for years. Considering today's growing demand for ICT products and services, which is a general trend not only in Serbia but throughout Europe, Serbian educational institutions face the challenge of attracting even more students and supplying more experts to the market.

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Table 14: Tertiary-type A and type B Education Programs in Serbia

	Serbian notation	Type	Level	Studding programs - translation	Title
OSS	Osnovne strukovne studije	B	I	Basic Vocational studies	B.Sc.
SSS	Specijalističke strukovne studije	B	II	Specialist Vocational studies	D.Sc.
OAS	Osnovne akademske studije	A	I	Bachelor Academic studies	B.Sc.
MAS	Diplomske akademske studije	A	II	Graduate Academic studies - Masters	M.Sc.
SAS	Specijalističke akademske studije	A	II	Specialist Academic studies	D.Sc.
DS	Doktorske studije	A	III	PhD studies	Ph.D.

Figure 19: Number of ICT Student according to Studying Programs in Serbia 2014-2017

Source: SITO 2017

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Distribution of new ICT Enrollees by Studying Programs

Total number of new ICT enrollees in school year 2017/2018 was 10,047, thereof 6,300 students begin their ICT education with tertiary type A studying program (OAS) and remaining 3,747 are with tertiary type B (OSS). For several years the annual growth of around 1,000 new enrolled ICT students has continued, indicating that rising interest for ICT studies corresponds to the ICT sector growing needs.

Key messages on the table and figure 20:

- The OAS (dark blue) presents the first level degree of tertiary-type A education (B.Sc.) and is, to a great extent (2,907 candidates or 46%) continued with further studies towards MAS and second level degree (M.Sc.), thus securing HR for ICT development
- For the most successful in tertiary type A education, the stud-

ies are completed with DS (Doctoral studies) and third level degree (Ph.D.), for which 512 places are provided.

The education that begins with the OSS (dark green) preserved mostly B.Sc. ICT experts (3,747 candidates), thereof only 674 candidates (18%) continued the (SSS) specialist studies, which shows the practical character of these studies.

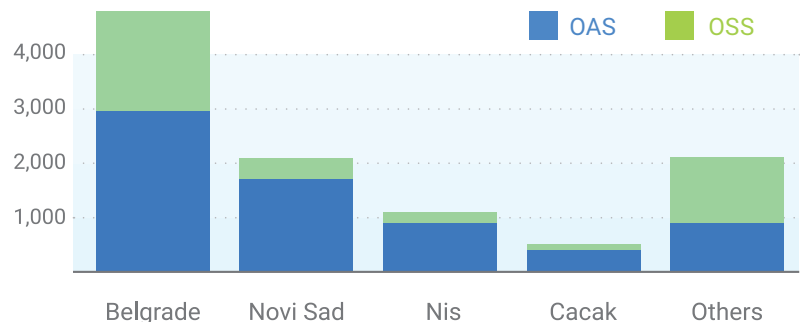## Number of New ICT Enrollees by Cities – Geographical Availability

There are 23 cities throughout Serbia where ICT studies exist, which provides very good geographical coverage. Education of personnel near industry centers is Serbian historical (traditional) heritage and that happens to be a good practice. Unfortunately, in the past two decades, industry was almost completely suppressed, but these preserved education capacities give the hope that faster economic recovery is possible.

Figure 20: Distribution of New Enrollees by ICT Study Programs, in 2017/2018
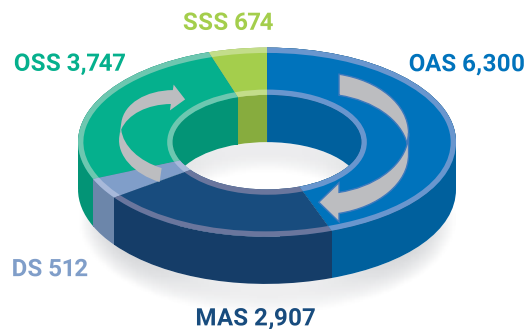
Source: SITO 2017

**Figure 21:** Number of New ICT Enrollees by Cities, in 2017/2018

Source: SITO 2017

Number of New ICT Enrollees by ownership of educational institutions

ICT program is held at 51 High Education institutions: 13 state owned universities, 19 private, 18 state owned (Vocational) Colleges, and only one private College.

Few students opt for private faculties, only 2,121 (21%). This is because the state-owned faculties have a tradition and studying expenses in their favor. More than 80% of ICT studies held at the state-owned faculties are covered by funds from the state.

Figure 22: Number of New ICT Enrollees by ownership of institutions, 2017/2018

Private owned Vocational (420) 4%

State owned University (4,856) 48%

State owned Vocational (3,070) 31%

Private owned University (1,701) 17%
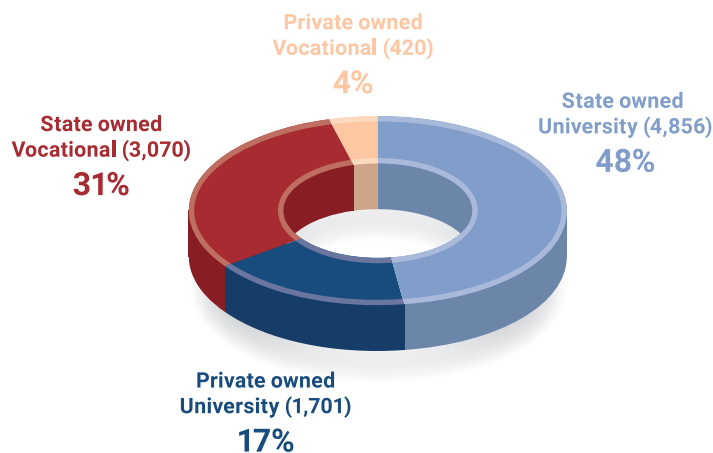
Source: SITO 2017

Number of ICT Enrollees and Enrolment capacity – Estimates and Trends

More than 16% of all Serbian newly-enrolled students in 2017 were ICT enrollees (10,047), which is a clear indicator of interest of Serbian young people in studies related to informatics. The overall enrolment capacity of around 14,000 is bigger, because all studying programs are split into three level degrees. After the first level degree (B.Sc. academic title), a student can continue his or her studies towards the second (M.Sc.) and third level degrees (Ph.D.). Therefore, students can achieve several academic titles during their studies. Consequently, the number of future ICT experts is limited to the number of new ICT students, but not to the number of academic titles achieved in that year (which we call here "overall enrolment capacity").

Therefore, the consolidated data show the structure in which the first level degree graduates are mostly expected (65%); they are followed by the second level degree graduates (30%) and, finally, as expected, the lowest number of the third level degree (5%).

Realistic estimate is that Serbia can count on around 3,500 ICT experts out of 5,244 ICT graduates in 2016, as the remaining number continued their studies towards the second and third level degree.

The reform of the University education sector (after the Bologna reform) and raising the number of ICT profiled experts are yet to show their positive results in the years to come. It seems reasonable to expect that Serbia will have more than 4,000 new ICT experts on an annual basis.

The present analysis covers only technical and technological professions and does not include around 800 IT graduated students from economic and around 500 from mathematical science.

Additionally, the corps of mechanical engineers of almost 1,500 graduating every year is interesting from the aspect of HR with ICT skills.

ICT and Vocational Trainings[20]

Serbia is simultaneously engaged in a number of VET reform activities that have a shared objective, namely – improving the learning and labor market outcomes of its students and adult learners in order to increase the country's competitiveness on the global and regional markets. The Government strategic priorities and action plan refer to this goal. Prompted by Serbia's commitment to the priorities set by the Riga Conclusions (2015), the law on dual education was approved. The adoption of a national qualifications framework (NQF) has been prepared with sound methodological work whereas the law to institutionalize the approach is yet to be approved.

While Serbia is managing simultaneous VET reform activities, the big picture and the way the different reform activities relate to each other are not sufficiently recognized. The EU further refers to enhancing inter-governmental coordination, as a means to smoothen implementation (European Commission, 2016).

Some of the critical stages of the VET and skills development process do not have a clear institutional ownership. This is the case with the updating of occupational standards and the National Classification of Occupations (NCO). Other elements of the system are being developed, such as an integrated NQF and the establishment of effective sector councils and will have to be put into practice.

The pace of technological change would require more timely skills adaptation processes. To this end, communication between those assessing skills needs and those in charge of VET content update should become effective. Coordination and cooperation can help linking the large building blocks of the national VET reform, and recognizing the big picture and the interdependence of the different reform activities.

Available Skills and Skills Gaps

In 2016, a survey on IT skills needs was conducted by the European Training Foundation, and both employers and employees were surveyed in the ICT field. Here we give a short excerpt of the main findings.

The ICT sector in Serbia, and especially in Vojvodina, is growing faster than the educational and training institutions capacities

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20 Source: European Training Foundation, http://www.etf.europa.eu/web.nsf/pages/Institutional_coop_in_VET_Serbia, http://www.etf.europa.eu/webatt.nsf/0/0A2814EFC7BF-6440C125822E00573883/$file/Digital%20factsheet_Serbia.pdf, http://www.etf.europa.eu/web.nsf/pages/ICT_skills_needs_analysis_Serbia - this analysis was performed in close cooperation with Vojvodina ICT Cluster.

can respond to the demand for qualifications. Among the 85% of companies, difficulties in filling job vacancies were identified as a result of either insufficient supply of qualified job candidates or a lack of applicable knowledge. The ICT occupations in high demand are developers, digital media specialists, ICT consultants, project managers, test specialists and system administrators. There are other professional profiles that also generate ICT sector workforce demand, including the positions of managers and marketing, sales and human resource specialists.

ICT companies prefer their workforce to have higher education qualifications, and such individuals composed 78.6% (76%) of the total hiring in 2016. The companies employed 12.9% of secondary and post-secondary VET graduates in 2016, while there is still an estimated demand of 23.8% expected to be filled in 2017.

Public policies created to improve the match between skills and jobs should be more sensitive to ICT sector needs. In that respect, further improvements to the current system of skills identification and anticipation are necessary. Also, IT clusters, in their role as knowledge hubs, can contribute to better matching between skills and jobs through strengthening the links between the educational institutions and companies and other stakeholders. Both employers and employees shared the same view on the top priority for change in the education system, ranking first out of four proposals – strengthening the practical dimension of education.

ICT professionals identified in-company coaching and on-the-job learning as one of the most popular ways to support professional development. ICT professionals and other employees would chose professional (technical) training, and courses that would improve foreign language, managerial and time management skills, while the employers would add communication skills training to this list.

A relatively small proportion of the ICT companies (25%) maintained links with secondary education institutions, whereas cooperative relationships with the higher education sector were more common.

Informal education, post-secondary VET and self-taught individuals were identified as the three most likely sources for overcoming skills mismatches and ICT qualifications shortages. More focus needs to be placed on strengthening informal and non-formal opportunities for learning.

The problem of qualifications and skills shortages occurs at the local level. However, educational polices are made at the national level, whereas conducting continuing training relates to the incentives proposed at the local level and can be supported by the local and provincial authorities. Establishing efficient mechanisms of cooperation and partnerships between relevant stakeholders is an imperative for the improved matching of workforce skills and ICT sector needs. Having a functional institutional setting is a prerequisite for effective cooperation between the ICT sector and the Government at all levels.

Research and Development

This chapter provides the following information:

- Current situation regarding R&D in Serbia in general
- ICT R&D in Serbia: Infrastructure, Centers of Excellence
- EU support dimension

According to the European Commission[21], Serbia has a good level of preparation in the area of science and research. Some progress was made with the adoption of the strategy for scientific and technological development. In the coming period, Serbia should in particular:

- Adopt the action plan to implement the strategy, and the science and research infrastructure road-map;
- Foster cooperation between the industry and academia and increase the level of investment in research.

Current Situation Regarding R&D in Serbia - in General and ICT Related

Although the country has a relatively good base in the area of science, the level of investment in research is less than 1 % of GDP, while cooperation between the public and private sector is weak, lacking systemic support.

In Serbia, there are 16,592 scientists involved in research and development that is carried out at 60 registered scientific and research institutes and 101 faculties. Most of them are state-founded, but they are also the largest research organizations from the business sector. To avoid misunderstanding about the business sector presence, it needs to be mentioned that the official statistics only cover market-oriented institutes which are founded by the state (e.g. IMP, IRITEL).

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21 European Commission – Commission Staff Working Document Serbia 2016 Report, Brussels, 2017

Table 15: Number and Dynamics of Researchers in Serbia, 2011-2016.

Sector	2011		2016		Trend 2016/2011	
	Number 2011	Share 2011	Number 2016	Share 2016	Growth (%)	Gained (% point)
Business	165	1.2%	2,071	12.5%	1,155%	11.3
Government	2,929	21.5%	3,011	18.1%	3%	-3.4
High Education	10,506	77.2%	11,502	69.3%	9%	-7.9
Other	9	0.1%	8	0.0%	-11%	0.0
Total	13,609	100.0%	16,592	100.0%	22%	0.0%

*Source: Statistical Office of the Republic Serbia*

Figure 23: Number of Researchers in Serbia by Sectors, 2011-2016.
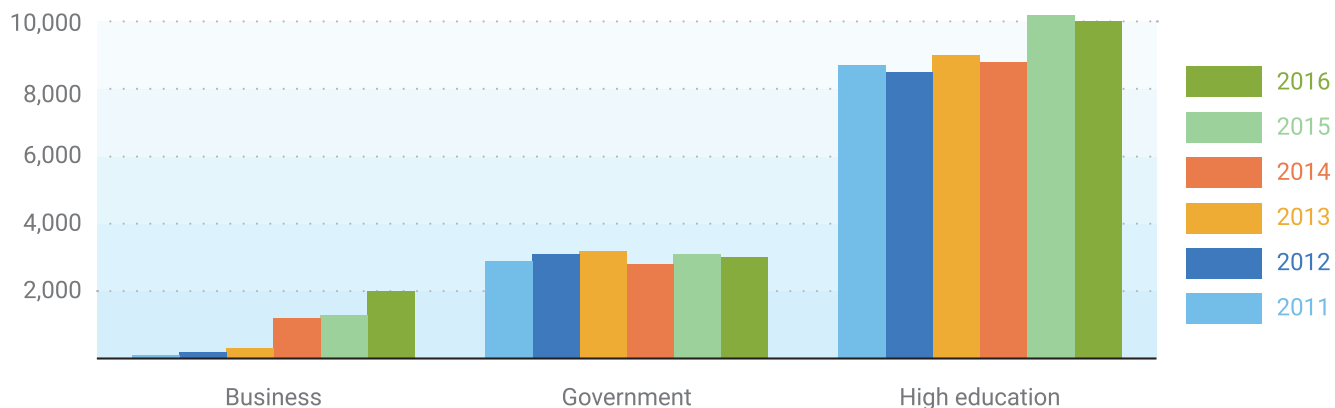
Source: Statistical Office of the Republic Serbia

Key messages on the table 14 and figure 22:

- 16,592 – Number of researchers in Serbia in Serbia 2016.
- 15,015 – Number of researchers according to FTE (Full time Equivalent) in Serbia, 2016.
- The Serbian business sub-sector counts only 1,993 researchers. This indicates that dominantly state-owned companies are recognized by official statistics.
- In the total number of researchers, in 2016, the business sector was involved with 13.3%, the government sector with 19.9%, higher (tertiary) education with 66.8%.
- The number of researchers employed in the R&D increased in 2016 by 2.5% compared to the previous year, and 28% in comparison to 2011.
- In the total expenses for the R&D (€309 million) in 2016, the share of gross investments (investments in infrastructure) is 6.3% while 93.7% are actually salaries for researchers (57.1%), and the rest (36.6%) for the costs of experiments and operating expenses.

Figure 24: R&D in OECD and Non-OECD Countries, 2017
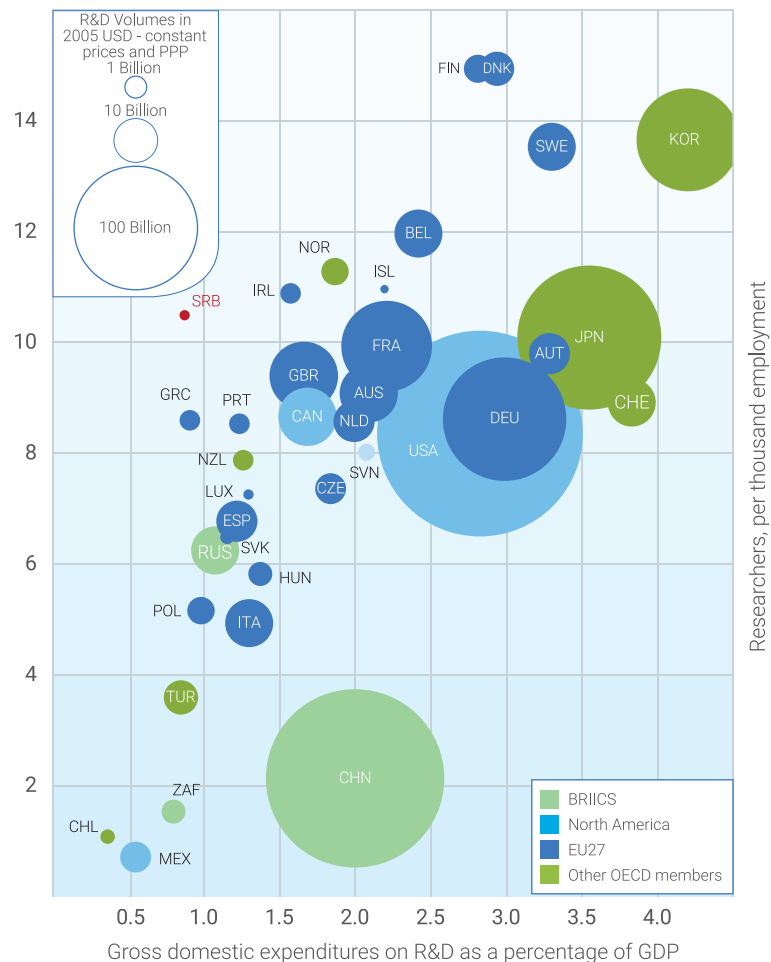
Source: OECD Science, Technology and Industry: Scoreboard 2017, SITO 2017

In the Figure 24, three components have been compared simultaneously: (1) gross domestic expenditure on R&D as a percentage of GDP; (2) Number of researchers, per thousand employed; (3) R&D volumes in Euros.

According to the level of investment in R&D (around 0.9% of GDP) and R&D value in 2016 (€ 309 million) Serbia is positioned low. On the other hand, with 16,592 researchers, which is about 10.0‰ of total employees, Serbia is at the world average. According to the Lisbon declaration, financial resources for R&D in EU members and candidate countries, should reach **1% of GDP from the budget and 3% of GDP in total**.

The value of all investments in Serbian R&D is not even comparable to the world renowned universities or institutes whose annual budgets are above €1 billion – each. The Government strategic goal for investment in R&D from national budget, excluding infrastructure, to reach 1% GDP, will not be achieved till the end of 2020. It stopped halfway (around 0.5%).

The financing of the Serbian science faces the problem of poor financing coming mainly from a single source – and then being distributed to a number of projects in the area of technological development.

The Government plays an active role in strengthening the Serbian ICT R&D capacities for three main reasons: (1) R&D (and ICT R&D) polices are set at the national level; (2) majority of ICT R&D activities are funded by Government institutions; and (3) majority of relevant ICT R&D research institutions are state-owned.

The total budget for science in 2016 was €309 million, and around 8% was allocated for both Electronics and telecommunications and Industrial software and informatics.

The private sector in Serbia is only marginally involved in ICT R&D and the role of ICT R&D business sector in Serbia is a modest one. There is low or no connection to ICT R&D institutes. However, companies from private sector are business oriented and long for applied solutions. Between these steps lies currently hidden potential for R&D. The Government almost exclusively follows up and regulates the relationships inside ICT R&D area of state-owned entities and their financing.

Although the Serbian ICT R&D system is of limited efficiency, this sector is alive and active, mainly thanks to the ingenious isolated individuals. A number of activities seems to come from a single or small group of individuals who invest their knowledge, expertise, authority, and energy – with no or insufficient Government support.

Serbian ICT R&D Legal and Policy Framework

The main priorities of the European Research Area roadmap were incorporated in the new strategy for scientific and technological development in March 2016. At the same time, several amendments were adopted to the Law on Scientific Research, enabling a more targeted approach to public funding of research institutions. So far, the strategy has not yet been actively implemented.

The absence of this Action Plan illustrates what is typical of the most adopted Serbian strategies – dead letter. Consequently, the main function of strategies is reduced to fulfilling the conditions prescribed in the EU accession process. To cut the long story short, if Serbia wants to get closer to the EU, the progress in R&D area has to be far more efficient, faster, and supported by legal and policy frameworks. Without this support, ICT R&D will develop spontaneously as it has so far, but it could be too slow for EU integrations.

ICT R&D Infrastructure

The information and communication technology infrastructure has expanded over recent years. Almost two-thirds of households have the Internet access at home. Public services offered via e-government are slowly expanding. The number of their active users has also continued to increase.

Analysis based on desk research shows that the current infrastructure for ICT R&D activities in Serbia is undeveloped due to the low and irregular investments, inadequate – due to the short amortization period of this type of equipment and discontinuity in upgrades or renewing and only partially meets the real needs of Serbian science and research.

Considering the planned infrastructure for ICT R&D activities, the main Government plans are connected to the Government project for investment into the Serbian R&D infrastructure, worth €400 million which started in March 2010 and is projected to last till the end of 2020. **The budget planed for ICT infrastructure is between €50 - 80 million**.

In 2010, European Investment Bank (EIB) and the Serbian Government signed a €200 million loan for the Public Sector Research and Development (R&D) project. The project, with an estimated investment cost of €420 million, concerns a series of investments aimed at revitalizing the country's public R&D activity. The investments include the upgrading of the existing infrastructure, the creation of a center for promotion of science, the construction of accommodation for students and young scientists, and creation of centers of excellence in priority research fields. Less than 2/3 of the plans had been implemented by the end of 2017. There is the impression that focus and priorities have been lost. This could bring the Serbian R&D into a difficult situation after EIB funds have been spent.

ICT R&D Centers of Excellence (CoE)

As a new institutional form - the Center of Excellence (CoE) was established in Serbia in mid-2008 according to the Law on Research Activities and following the Rule Book and prepared by the National Council for Science and Technological Development. The appearance of CoE in Serbia is more than 5 years late in comparison to EU12 countries.

As in Serbia this type of entity has just begun to develop, it will take significant amount of time and money to achieve its full implementation in the following 3-5 years. The existing CoE as real leaders

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of ICT R&D activities in Serbia has not been recognized yet. This should happen in the time to come.

Potential CoEs in this analysis include ICT R&D organizations and research units with necessary critical mass of knowledge, resources, and infrastructure, capable of achieving research results.

The adopted criteria for identifying the potential CoE is primarily based on the total number of ICT R&D researchers at particular research unit (not the entire organization) combined with the achieved success in "HORIZON 2020" projects. Whenever it was possible (based on the public available data or good estimation), the number of implemented projects and number of published scientific works were taken into account. In addition, the high expertise and/or market approval in ICT area of the entities were considered. Based on the criteria above, the selected entities were classified into three groups of potential CoE: a) centers of competence, b) centers of potential for "HORIZON 2020-ICT" and c) centers of best practice. One entity was classified into not more than two categories.

(a) **Centers of Competence** are entities with significant number of published scientific works and realized projects, and have a number of researchers with PhD. In this group the majority come from relevant state owned organizations (faculties' departments and institutes).

(b) **Centers of Potential** for FP7-ICT are entities that have been successful in HORIZON 2020-ICT Theme.

Table 16: Centers of Potential for HORIZON 2020-ICT in Serbia

ORGANIZATION	Number of projects in HORIZON 2020
BIOSENSE INSTITUTE NOVI SAD	12
INOSENS NOVI SAD	7
NISSATECH INNOVATION CENTRE NIŠ	6
DUNAVNET NOVI SAD	5
INSTITUT MIHAJLO PUPIN BEOGRAD	5
BELIT BEOGRAD	3
RT-RK NOVI SAD	2
BITGEAR WIRELESS BEOGRAD	2
NOVELIC BEOGRAD	1
BIOIRC KRAGUJEVAC	1

Source: CORDIS, 2017

(c) **Centers of Best Practice** – are exclusively ICT companies (from business and industry sector) which have a good market reputation, strong references, have been recognized and are well known by specific expert community, or recommended from the person of authority (in specific areas).

Around 70 organizations have been identified as potential CoE: 40 centers of competence, 10 centers of potential for HORIZON 2020-ICT and 30 centers of best practice.

The authors are aware that the presented list is not complete. There are ICT entities which have participated in HORIZON 2020 projects, both successfully and unsuccessfully, in non-ICT areas which have not been taken into account. In addition, there are ICT entities (research groups and individuals) inside organizations whose basic field of work is not ICT.

ICT R&D Expertise

Although mapped to FP7 themes (objectives) expertise, the table below is a good illustration of the ICT R&D expertise in particular areas. All objectives (High competence - High share) with the square frame, are confirmed expertise and successful FP7 projects.

EU Support Dimension

Serbia continues to be active in the European Research Area Committee and in the EUREKA, COST and NATO Science and Peace for Security programs. The level of investment in research remains below 1% of GDP. Since the start of participation in HORIZON 2020, 1,309 applicants from Serbia have taken part in 1,006 projects and 91 of them have been selected for financing.

Serbia is oriented toward the EU cooperation programs, which is illustrated with a number of joint scientific papers. The most fruitful R&D cooperation is with the USA, mainly thanks to Serbian science diaspora. Cooperation with Germany and Italy follows. CERN cooperation is in the fourth place, right before cooperation with UK. It is

Table 17: Competence Share of Declared Expertise per Objectives

	ORGANIZATION
1.1	The network of the future
1.2	Internet of Services, Software and Virtualization
1.3	Internet of Things and enterprise environments
1.6	Future Internet experimental facility and experimentally-driven research
3.3	Embedded Systems Design
3.4	Computing Systems
3.7	Networked embedded and control systems
4.3	Digital libraries and technology enhanced learning
4.4	Intelligent Information Management
5.3	Virtual physiological human
6.3	ICT for the environmental management and energy efficiency

Source: CORDIS, 2017

understandable that EU scientific area plays an important role for Serbia and its R&D.

Participation in the FP7-ICT Theme

EU Commission, which financed R&D of Serbian researches through the Seventh Framework Program (FP7), is the most significant international partner for Serbian science. FP7 spans the period from

2007 to 2013, with a budget of €50.5 billion. On June 13, 2007, Republic of Serbia gained the status of Associated Country within the EU Seventh Framework Program for Research and Technological Development.

Statistical data for the first five years of the Program (by the end of 2011) showed that researchers from Serbia participated in the preparation of 1.161 draft projects. Of that number, 154 projects were granted funding, making the success rate of 13.2%. After FP7 had closed in 2014, the European Commission provided overall data, which revealed that 292 participants from Serbia received €52.2 million.

If we assume that Serbian participants in all FP7 projects received the same part of contracted money, ICT R&D in Serbia got 1/7 of total sum, or €5.0 million for five years. If other multidisciplinary cooperation (Joint Call) strongly connected to ICT are taken into consideration, the FP7 contribution to the Serbian ICT R&D sector will be between €1 and €2 million per year.

Horizon 2020 (H2020)

After finish of the FP7, the new program - Horizon 2020 has started. It is the biggest EU Research and Innovation Program ever, with nearly €80 billion of funding available during the period of 7 years (2014 to 2020). It promises more breakthroughs, discoveries, and world-firsts, by taking great ideas from the lab to the market.

Serbia sees its chance in equal participation in H2020. However,

there is a potential for a big financial risk. In previous FP7 Program, Serbian participation in the total budget was around 0.001%. Realistic assumption is to presuppose that Serbian participation in HORIZON 2020 could reach 0.002%, which makes around €160 million for the period 2014-2020. On the other hand, it is hard to expect that the participation of Serbian organizations is going to double in comparison to FP7. This would virtually mean that poor Serbian economy becomes a financer for rich EU science. In order to avoid this threat, it is necessary to include monitoring system for tracking balance between national budget participation in H2020 and inflows of the research organizations through obtained projects.

Participation in H2020-ICT Theme

On the basis of statistical data for the first four years of the Program (by the end of 2017) researchers from Serbia participated in the preparation of 1,006 projects applications. Of that number, 134 projects were granted funding, making the success rate of 13.4%. According to the European Commission data, 198 participants from Serbia received €50.1 million.

The first ICT-Leadership in Enabling and Industrial Technologies (LEIT) Work Program under H2020 provides a balanced response to the main challenges faced by Europe in the field: firstly, the need to maintain a strong expertise in key technology value chains; secondly, the necessity to move faster from research excellence to the market.

Serbian R&D organizations should be introduced to H2020 themes and objectives and map their expertise accordingly. In addition, it is of great importance for Serbian research teams to take part in ICT-LEIT activities thus expressing their higher interest in international cooperation as well as strengthening their skills and expertise.

Six main activity lines have been identified as compatible with the Serbian R&D in the ICT-LEIT part of the Work Program:

- A new generation of components and systems
- Advanced Computing
- Future Internet
- Content technologies and information management
- Robotics
- Micro- and nanoelectronics technologies, photonics

Software Sector: Opportunities on International Market

This chapter deals mainly with the Serbian software sector comprising companies whose specific focus is on the international market, providing software product, software licenses, and IT services development. The chapter covers the following information on the export-oriented software sector as an important part of the IT industry:

- Export-oriented software sector - Current situation
- Trends and potentials
- Combined Profile of Top 15 export-oriented software companies
- SWOT Analysis – Opportunities and Barriers

Software Export Sector - Current Situation

Identification and evaluation of Serbian Software sector has to rely on the description of the current situation in Serbia, local and global IT trends identification and analysis, and on the potentials for Serbian companies that are arising from the identified trends. [Source: SITO, 2017]

Total of 304 active enterprises, whose predominant activity (revenue) is software and IT service export, make the Serbian software export sector in 2016. The total number of employees is 10,068 and represents 47.0% of the total IT workforce in Serbia. The average number of employees is 33 and the average revenue and added value - per employee, were €38,000 and €29,000, respectively.

Total revenue of the outsourcing sector is € 385 million, while the Serbian computer and information services export is by 53% higher (€ 590 million). The difference comes partly from the large system integrator and software companies exports, while their predominant revenues are from their activities on the local market.

Apart from that, the big IT international players present on the Serbian market through their local branches, such as MICROSOFT; IBM, HP, CISCO, ORACLE, and SAP, are largely on their corporate budgets, which makes their currency inflow obvious.

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Table 18: Basic Business Indicators of Software export sector vs Top15 in 2016.

Software export sector	2016	Top 15	Index - Top 15 (%)
Number of Companies	304	15	4.9%
Workforce. Number of Employees	10,068	3,657	36.3%
Average Number of Employees	33	244	736.1%
Revenue (€)	385 million	157 million	40.8%
Revenue per head (€)	38.000	43,000	112.6%
Added Value (€)	296 million	134 million	45.3%
Added Value per head (€)	29.000	37,000	12.2%
Net Assets (€)	212 million	91 million	42.9%
Net Assets per head (€)	21,057	24,800	117.8%

Source: SITO 2017

Business Concentration – Top 15 Software Exporters

Business concentration of Serbian Top 15 software exporters has been decreasing year after year, illustrating their slower growth rate than the sector average. Fifteen biggest software exporters according to the revenue in 2016, employed 36% of the software export sector workforce generated 41% of the sector revenue and 45% of the sector added value. Net assets of top 15 are 43% of the total sector asset.

Figure 25: Business Concentration [%] on top 15 Software Exporters in 2016.

Source: SITO 2017

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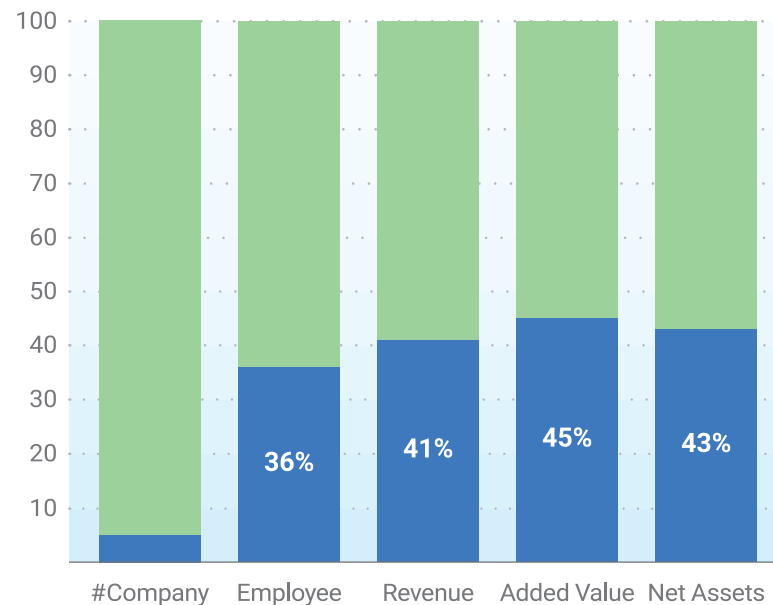
Who are the software exporters in Serbia?

The Table 19 illustrates the present Serbian Software export scene and those who have recognized the chance and got involved in export. It shows the two dimensions of the Software exporters: ownership and organizational form. The quadrant is divided into four regions: the vertical axis represents the ownership: local/foreign, and the horizontal axis the organizational form: business company (LLC)/others.

Key observations from the quadrant are:

- Among 200 chiefly exporting companies, and according to the generated revenues, 138 of them is in outsourcing, while the remaining 62 generate most of their revenues by selling their own solutions. Outsourcers employ 82% of the workforce, and generate 69% of the export.
- In terms of ownership of the 200 biggest IT exporters, 88 were founded by foreign persons or companies (first quadrant), employing 58% of the workforce and generating 54% of the export revenues – dealing almost exclusively with outsourcing.
- In the first quadrant (1), the top five software exporters with foreign ownership are listed representing the major outsourcing resource in Serbia: in revenue, number of employees and in investments. Big investments in this sector started with SCHNEIDER ELECTRIC DMS NS since October 2012, while GTECH (USA) has been characterized with smaller, but continuing investments for more than a decade. These two leaders

are focused on their own products development, and the needs on the global market. Seven Bridges is the leading biomedical data company, specializing in software and data analytics to drive healthcare research.

Table 19: The ownership and organizational form of the leading software exporters 2016

	Other	Business company (LLC)
Foreign Ownership	BRANCH-OFFICE (MICROST, HPE, IBM CISCO, ORACLE, SAP) EMPLOYMENT AGENCIES (4)	SCHNEIDER ELECTRIC DMS LEVI 9 GLOBAL SOURCING GTECH PSTECH SEVEN BRIDGES (1)
Local Ownership	FREE-LANCE (Individuals Start-ups Entrepreneur Small agencies) (3)	RT-RK NORDEUS COMTRADE S.E. EXECOM HDL DESIGN HOUSE (2)

Source: SITO 2017

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- Mostly, others from the first quadrant are Outsourcers who provide programming (coding), testing software, designing websites, and developing solutions in the embedded industry.
- The second quadrant (2) includes very important Software export business companies owned locally. Five companies listed in this quadrant are the leading ones among numerous domestic software export companies.
- Local companies are almost evenly divided into outsourcing and selling own solutions, which will not be enough to change the structure of the entire IT export in the near future. Therefore, outsourcing will dominate the export even after 2020.
- In the third quadrant (3), there are entities with local ownership, categorized as "Others"- which denotes freelancers. The specific significance of the freelance market has to be further explored as, on one hand, this group involves an unknown number of readily available skills and expertise and, on the other, a large group of individuals without the economic basis or chance for permanent employment and with all the difficulties coming with this status.[22] In this quadrant, one of the common forms of software business organization is a small entrepreneur agency. Finally, this quadrant may also include start-ups at incubators, innovation centers and clusters. Start-ups should be supported and stimulated as one of

the transitional forms from freelance to company status. Educational and motivational programs could help relocating significant Outsourcing corpus from quadrant (3) – freelance to quadrant (2) – business companies.

- The fourth quadrant (4), which contains branch-office and employment agencies, represents the informal set of business activities, which foreigners use before the formal beginning of the outsourcing. For now, greenfield investments are more often than not present in Serbian outsourcing, while acquisitions, although less frequent, are reserved for the biggest deals (for example SCHNEIDER ELECTRIC DMS and GTECH). More acquisitions are expected in the future, as practice shows that companies with revenue exceeding € 5 million are becoming interesting to foreign investors.

Local branches of big international players: MICROSOFT, IBM, HP, CISCO, ORACLE, and SAP are also classified in the fourth quadrant (4). Although software export is not on their business line, their main business activities are a significant part of IT service export from Serbia.

Added Value in the Serbian IT Industry

Added Value can be defined as the difference between a final selling price of a particular product and the direct and indirect input used in making that particular product (see Terminology). The importance of Added Value as parameter comes from the spotted rule: high Added Value provides high profitability.

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22 As of recently, banks in Serbia started to recognize registered entrepreneurs as prime candidates for bank loans, thus mitigating some of the important setbacks inherent to their status, such as non-existence of credit rating and ability to take loans.

Figure 26: Structure of IT Industry Sub-sector (%) in Added Value, 2016

- Software
- IT Services
- IT Channels
- PC Hardware
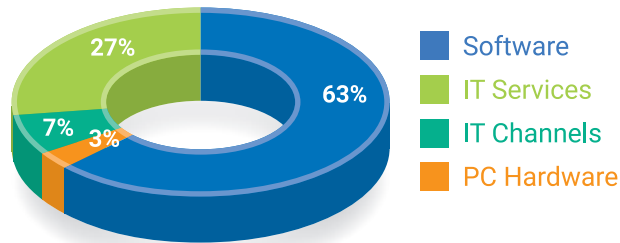
Source: SITO 2017

Serbian IT companies have accomplished Added Value amounting to 629 million, which is 34% of the IT industry revenue in 2016. This amount makes 2% Serbian GDP - an obvious increase in comparison to 1.2% five years before.

Key comments for figures 26 and 27:

■ Software sub-sector with 63% share achieved the highest added value (€398 million), IT services sub-sector follow (€170 million, 27%), IT Channels sub-sector (€43 million, 7%) is in the third place, while the shares of other sub-sectors were significantly lower.

Figure 27: Structure of Software Sub-sector (%) in Added Value, 2016

- Software Exporter
- ERP Specialist
- Other Software
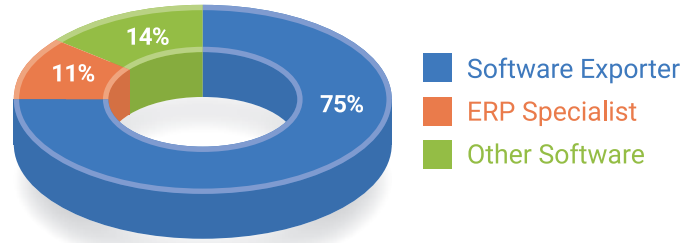
Source: SITO 2017

■ The SME segment accomplished €430 million in 2016 and 68% share in total added value of the IT industry

■ Software export sub-sector of the Software sector amounted €297 million (75%). It is the largest part and illustrates its significance and potential.

The software and IT services become the most challenging markets. System integrators and software companies who recognized the fast growing service market and jumped on that wagon, achieved success. Additionally, companies that partnered with global IT vendors progressed rapidly thanks to the adoption of global experience and expertise.

Software Export Sector - Trend and Potential

Market trend and potential

On the global market, IT companies from Serbia (SME and big ones alike) are involved in different outsourcing roles: writing codes (programming), testing software and designing websites, but also providing solutions in the embedded industry. The main markets for outsourced industry are EU followed by the USA.

Figure 28: Export of Computer and Information Services, 2007-2017 [€ million]
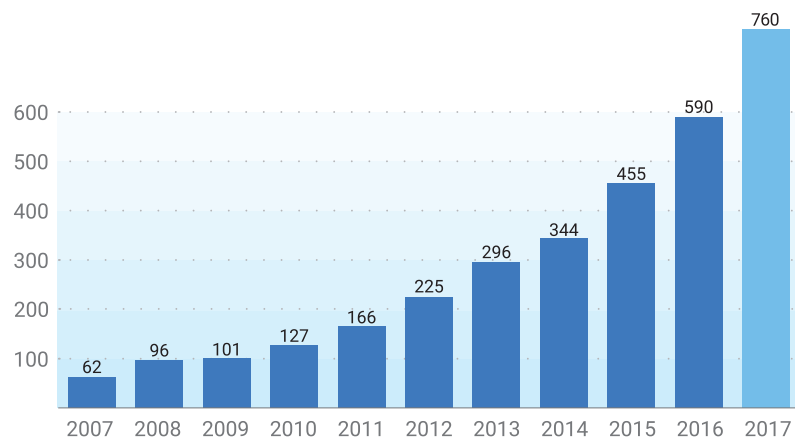
Source: NBS

Until a couple of years ago, one could still say that the Serbian IT export was lower than expected. If Serbia is to become a respectable offshore destination for software development, the ratio of IT services export to GDP has to be much higher than the current 2%. The analysis of the ICT export shows that the export base in 2008 was low, which allowed high growth rates to begin with. However, the continuing development of the sector up to 2017 created significant cumulative effects and this picture has significantly improved today.

In this chapter a wider meaning of the term software export market is used, so that it includes the total Serbian revenue from computer and information services export excluding hardware. In 2016, total revenue of the software export sector is €397 million, whereas the export of the Serbian computer and information services is higher by 54% (€590 million). The difference between used terms revenue and export is explained at the beginning of this chapter. Local branch-offices, such as MICROSOFT, IBM, HP, CISCO, ORACLE, and SAP, generated more than €50 million from export. A similar amount (€50 million) was exported by the system integrators, while the rest of €100 million came from many others.

The software export share in GDP has been rising year after year (from 0.3% in 2008 to 1.0% in 2013, and to 2.0% in 2017). The main reason is a significantly faster growth rate of the Software export sector in comparison to the rate of the remaining part of the Serbian economy.

Who profits most from the growth of the Serbian IT export?

Simplified formula to calculate the export potentials of domestic IT industry is:

Export = Outsourcing export + Own Solutions export

By the optimistic estimate, export could reach one billion euros in 2020. In any case, IT in Serbia will continue to grow as before – spontaneously riding the wave of global technological progress. If the Government decided to get involved, but in a smart way, and with measures to support IT industry, then the €1B estimate could be surpassed.

With €300 million, outsourcing comprised around 75% of the total IT export in 2015. Serbian export-oriented IT sector is owned by foreign capital, and business stability of these companies is secured through revenues created on their home markets, outside Serbia. Based on market activities so far, we can expect those companies to double their workforce in Serbia by 2020, and number of employees is the key growth factor in their business model. Those revenues will have reached €600 million in that period.

On the other hand, IT companies who export their own solutions create €57,500 revenues per employee, which is double the figure in the outsourcing model - €27,700. In relation to the total annual average income per employee of €32,300, the annual revenues per employees index is 178% for exporters of solutions, while in outsourcing it amounts to 83% only. Still, it is hard to expect that the Serbian companies would manage to use their own solutions to secure more than €200-€300 million in exports by 2020. Why? Because as soon as the annual revenue of any local company tops ten million euros, their business moves abroad or is sold to a foreign owner. After that, the budget left in Serbia is for salaries only.

With the continuous and spontaneous approach, there are minimal chances for any significant changes by 2020, and outsourcing will, unfortunately, remain a dominant part of the Serbian IT export. Strong support of the Government to companies which develop global solutions would be wise, and trusting domestic companies in big procurements of IT products and solutions would be a huge step in the right direction. References and experience gained this way would help realize own solutions export worth €400 million in 2020. All this would help create a vibrant environment and the eco-system in which domestic technology companies could create even larger added value in Serbia. Also, stability/safety of such IT solutions is typically stronger than when relying on foreign IT solutions.

 If the Government decided to get involved, but in a smart way, and with measures to support IT industry, then the €1B estimate could be surpassed

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Figure 29: Intra-European Offshoring Market Growth Pattern
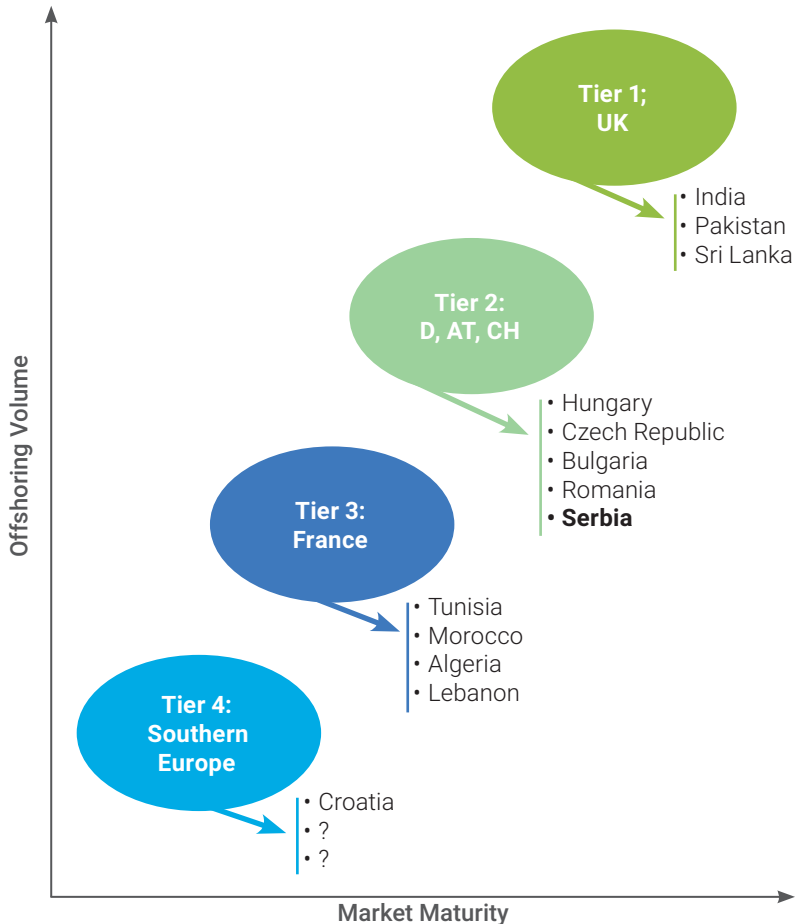
Source: GOPA Consultants

Global and EU market trends, and offshore outsourcing potentials

Considering global and especially German market trends, the (offshore outsourcing) potentials for Serbian companies have become clearly visible. Exploitation of these potentials depends on several factors: preferences of European companies for near-shoring to Eastern and South Eastern Europe due to the proximity and cultural similarities, positive cost-benefit-ratio of relatively inexpensive but skilled labor (combined with lack of experts in some markets like Germany), exceptional language skills, and rising wages in other markets (e.g. India). The trend towards smaller and shorter projects additionally helps Serbian SMEs. The strong position and growth predictions can be seen in the following chart where Serbia is listed as a mature market with respectful volumes.

Regional market of Southeast Europe (that includes Western Balkan countries) in the picture above, is not visible as it is of a small volume and immature. This market is expected to grow and become visible in the foreseeable future. Serbian IT companies expect to benefit from the following dimensions of proximity: geographic, time zone, cultural, linguistic, economic, political, and historical linkages. On the regional IT market, Serbia has absolute and comparative advantage in comparison to its neighbors. So, it is possible for Serbian companies to appear in two roles: vendors for regional customers and nearshoring market for regional IT companies.

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Workforce trend and potential

Current demand for IT experts is far larger than the offer, which leads to a disorder in the labor market. Higher salaries have become the chief instrument for IT companies in attracting owners of IT skills. In doing so, they contribute to the trend of growing salaries and they heighten junior developers' expectations who anticipate €1.200 starting salaries. It is not easy to define what realistic salaries of IT experts in Serbia are today. It has become an individual value within a wide range. Differences among companies, within a company, among positions, according to work experience etc., range from 1 to 10. And everyone sees the 10. That is why appeal of IT studies is stronger than ever, and attracts "undecided" candidates. There are numerous tasks before the Government, and certainly the most important task is educating the IT staff in larger numbers, as those are the main moving force of the entire IT development, with the state being the major founder and financier of almost all high education institutions. That is why investments in this area have to be as big as possible, while additional action is needed to minimize brain drain. We are facing big challenges regarding raising quality and quantity of

Table 20: Workforce of Top Software exporters 2009-2016

	Company	Domestic	Top 15 2009	Top 15 2016	Index - Top 15 (%)
1	SCHNEIDER ELECTRIC DMS NS	N	142	895	30%
2	RT-RK	Y	51	561	41%
3	PSTECH	N	70	356	26%
4	LEVI 9	N	102	314	17%
5	GTECH	N	129	215	8%
6	NORDEUS	Y	-	126	N/A
	TOTAL		494	2,467	26%

Source: SITO 2017

IT studies. However, demography is not on our side, so the question of the good measure and maximum achievements is becoming essential. Regarding the capacities for studying, we are probably nearing the maximum, while there is always room for raising quality.

It must be taken into account that in order to achieve the minimum of EU standards, Serbia need to raise the rate of IT investments per capita from the present €60 to €150, which is the total of €1 billion per year. Such level of investments calls for 20.000 IT experts to focus almost exclusively on the domestic economy. Current engagement in that field is less than 5,000 qualified experts. If, however, current trends continue, after 2020 Serbia will keep selling its workforce cheaply, buying foreign solutions instead of domestic ones in excess of €500 million every year.

Apart from the arguments politicians use to support IT industry, we need to point out possibly negative scenario and consequences of the strong focus on export, while local IT needs are neglected at the same time.

All of this is a huge challenge which previous governments have not or could not deal with. Looking at the export only, neglecting domestic IT needs, Serbian companies will remain non-competitive and the state disordered. That would be a gloomy perspective for digital transformation in Serbia.

As an illustration of the Software export sector dynamic progress we used the workforce growth rate of the 6 leading companies in the period 2009-2016.

Key observations for table 20:

In 2016, total workforce of 6 leading companies in the Software export sector was 2,467 employees, which is 5 times higher in comparison to 2009! This is a good sign, especially in the situation of growing general unemployment where every position is important. In the same period (2009-2016), the economic crisis left the total IT workforce unchanged, proving the momentum and vitality of the Software sector. In addition, this vitality is opposite to the overall economy trend, where, due to the recession and economic crisis, total workforce shrunk by more than 100,000 workplaces.

Total employment of the software sector, which is software export for the most part, has the increasing trend of more than 1,500 new employees per year, so most of IT graduates in Serbia find work soon after graduation. However, the lack of high quality IT experts for development, programming, designing, and web design is already noticeable. It is estimated that the software sector will attract majority of IT experts of highest quality for a longer period, thus increasing its competitiveness and significance in entire Serbian IT industry. Very soon, an insufficient number of experienced programmers could lead to disturbance on the labor, as the great number of employees will seek better jobs through changing companies or the positions inside the companies. The new phase is at hand in the area of certification and quality assurance, as the number of certified IT experts is going to rise significantly – as a consequence of the need to ensure competitiveness and quality for international clients.

Outsourcing Sector - Trends and Potentials

Outsourcing sector is the part of Serbian IT industry with the highest performances. All Outsourcing structural characteristics are better than those of the remaining industries. One of the best illustrations, and an important indicator, is Added Value analyzed in the previous chapter. Furthermore, if the average salary is used for the evaluation – it is 10-50% higher in Outsourcing than in other segments.

Serbian Outsourcing sector is on the path of big development, as it has just stepped onto the global IT scene which is incomparably bigger than its whole present and future capacities. Specialization and distancing from the mass competition is the way forward for successful entrance of Serbian companies on the global market.

Outsourcing sector development has to be tracked and supported by future analysis that include more precise classification of the outsourcing entities, due to all of their particularities.

International IT companies advance into the Serbian IT market attracted by its potential. Local companies are exposed to a strong globalization effect, but at the same time the global IT companies are exposed to the need of localization: to establish their own companies and local offices and employ local workforce. The international IT vendors have strengthened their local presence significantly in the past years by establishing their own companies for global services.

For most Serbian IT companies (almost exclusively for micro and SME) outsourcing contracts are simple and often the only strategy of survival. It is also the way to escape financially insolvent local IT market. Some of the reasons for this have been explained in more detail in the chapters and sections above, including the company size, access to the capital for development of their own products in the short and medium terms, low demand of local companies in other sectors, degree of specialization etc.

It can be assumed that, within the timeframe of the next ten years, taking improved access to the capital and IT professionals into account, outsourcing will remain one of the core pillars of services sold to local and foreign clients. Depending on how fast the ICT sector matures in Serbia and the region, the market will create an ever growing divide between companies which do outsourcing as a core (especially software development) or sole competence (specialized outsourcers) and those that work on outsourcing contracts occasionally.

There is no single pattern explaining Serbian companies' entry into the foreign markets. Although it is not possible to provide an accurate assessment of which of present models provide the most successful results, few common approaches are worth further elaboration. The models are as follows:

- Landing a contract through Serbian diaspora – connections of IT experts working abroad.
- Landing a contract at B2B events organized by the Government, clusters, international development agencies, and alike. All of them recognize Serbian ICT as a sector with high export potentials.

- Landing a contract through contacts created at international fairs. Usually companies start with smaller values of initial contracts, and thereafter develop trust and grow their cooperation into more serious contracts.
- In numerous cases, Serbian companies have obtained international contracts using their personal contact networks.

It is very important to emphasize that Serbian ICT companies lack the market intelligence about international markets: insufficient specific knowledge as to what the potential markets for their goods and services could be and how to access these markets.

Threats to Future Development

Because of the insufficiently encouraging ambient for domestic development and export of own solutions, we primarily have body leasing of smart workforce. In case of any stronger global economic instability, there is a real danger of a large number of IT experts moving abroad and formalizing such brain drain. The experience from the global crisis in 2009, but also the latest disturbances on global markets, show that crisis of big players is not the opportunity for Serbia. When crisis hits, states and large companies turn to their own resources, while Serbian economy remains without investments, with decreased demand, and without the best staff which gets taken away by foreign companies. In recent years, we had examples of some very successful foreign IT companies leaving Serbia literally overnight, taking selected employees along. That is why it is necessary to change the Government policies and aim at stimulating and improving support to creation of domestic software, including determination to trust domestic IT companies with large Government procurements. References and experiences from those projects would also help boosting export of domestic software solutions. That is the point in which €1 billion IT export, discussed above, would become more certain and sustainable in the long run.

Serbian Outsourcing sector is on the path of big development, as it has just stepped onto the global IT scene which is incomparably bigger than its whole present and future capacities. Specialization and distancing from the mass competition is the way forward for successful entrance of Serbian companies on the global market

Own Solutions – Best Practice Examples

Serbian Government is aware of the need to transform domestic economy into innovation-based economy. All efforts to attract global technology companies yielded modest results, which turned out to be good for the development of domestic IT capacities.

Among the outsourcing companies, a trend of making their own products with a high export value on the foreign markets has been observed. So far, a few companies have been successful, but these few companies have made a worldwide success.

One of the most difficult issues of assessing the Serbian IT industry is the question of how much of the available sector/industry specific knowledge can be translated and "packed" into different software products (applications). Already mentioned success stories (DMS, EXECOM, NORDEUS, etc.) illustrate taking advantage of such knowledge. These companies have developed business models based on their core competence, unique expertise and experience in a certain (technical) field, using their software only as a "wrap-up" and a way of how to deliver and market this knowledge. Programmers have been important, but not essential for developing such a business model. The knowledge, once developed and brought to a specific use, is not hard to "translate" into software products.

Experience and good practice of domestic companies which were successful on international markets are precious for further development of the IT sector in Serbia. We need to listen to such companies: Seven Bridges Genomics, proclaimed by the MIT to be one of the 50 smartest companies globally; BioSense Institute from Novi Sad, which is one of the European leaders in digital agriculture; ST Park in Belgrade, which gathered over 60 startups and innovative companies that export 75% of what they make; Technology Partnership, a company which is a part of the European scientific team behind the first ever scanner for malignant melanoma. We can learn a lot from the approach and creativity of Nordeus, the company behind Top Eleven - an online game with over 150 million users. It is necessary to support Startit centers that gather talented young people across Serbia and share knowledge and experience with all who want to learn how to start a business and create new, innovation-based value.

We need to recognize IT clusters for what they are – knowledge and business hubs, organizations with capacities to create new value chains, bridges within the triple helix of business-education-government – and use them as ideal channels of communication with IT community, as well as sources of inspiration when making decisions on where to go next.

Companies like Schneider Electric DMS NS, and RT-RK, successfully merged new technologies and innovation, and employ thousands of people in their research and development centers.

Examples like these are not that many, which is why their experiences are precious both for the Government and for further development of IT industry.

Summary

Understanding these success stories, visible much farther than Serbia, could be the starting point for finding potentials in different directions and dimensions (local, regional and international):

- **Own Solutions development.** The core competence of having excellent knowledge and understanding of an industry, its technology and processes is illustrated with the above-mentioned success stories.
- **Provision of services/products to other sectors.** IT companies often do not have a clear picture of specific needs and demands of other sectors when it comes to ICT products and services. However, some of them recognized this as an opportunity and developed high expertise in the sector of Telecom & High-tech, Banking & Insurance, Public & Health, and Energy & Utility.

Each success story seems different in many details. However, some of the key components are common, and could probably be used as the Best Practice guidelines. Here they are:

- Investment – the big amounts or smaller ones, but continual over a longer period (several years)
- Excellent knowledge and understanding of target industry, technology, and market
- Recognition of industry or other sector needs
- Workforce with high expertise
- Vertical or horizontal specialization
- Use of distancing strategy or focusing strategy
- Focus on more significant project roles
- Focus on developing own solutions/products

Combined Profile of Top 15 Software Exporters

The main intention of the combined profile is to point out the directions and dimensions on which the software exporters are focused and enabling a better understanding for potential investors. This profile is observed through 5 "focus dimensions" (from Q1 to Q5) and through two market features: market position (Q6) and users' loyalty (Q7). As the leading 15 companies visibly shape the whole software sector, it is useful to present their main characteristics using their combined profiles, which is presented in the Table 21.

Key observations on the Table 21:

- [Q1] Vertical focus of the Top 15 Serbian Software exporters is analyzed according to their expertise concerning the four key sectors for IT investment: Telecom & High-tech (7 IT companies are recognized to have solutions for this sector), Banking & Insurance (2), Public & Health (1) and Energy & Utility (4). All other sectors are in the category "Others" which holds on 10 companies with expertise for other industries. However, category "Others" has the highest average expertise mark (4.9 from 5.0 max) for solutions and services, while the Public & Health has the lowest one (3.0). SCHNEIDER ELECTRIC DMS for Energy & Utility and RT-RK for Telecom & High-tech have the most prominent solutions.

- [Q2] Horizontal focus of Top 15 Serbian Software exporters is slightly more visible in Solution Engineering (5 companies with expertise) and Gaming (2). Half of the Top 15 companies (8)

have their own solutions or products, thus proving how that is important. Naturally, these companies, regardless of their ownership, foreign (6 companies) or local (2), base their work on internal development. Two worldwide gaming leaders have the most prominent horizontal solutions: internationally owned GTECH and the locally owned NORDEUS. Seven companies offer a capacity for nearshore software development in the wide range of horizontals. All of them refer to cooperation with number of different clients.

- [Q3] Focus on developing their own solutions through internal development is significantly stronger among the Top 15 than among the rest of the software exporters. The business focus of the remaining Software export sector is mainly based on nearshore software development and on the number of different clients.

- [Q4] Focus on project roles is moving towards more significant ones. Eight companies work on Concept and Design, 12 on Software Architecture, 14 on Software development, 13 on System integrations, 12 on Testing, while 9 work on Deployment. Considering the experience and high expertise of the Top 15 software exporters, it is easy to interpret the good result in different roles in the software projects.

- [Q5] The target market rises the question of the Serbian companies' inferiority to the global competition. According to the target market, Top 15 Serbian software exporters are mainly focused on the global market as 11 companies (from Top 15)

Table 21: Combined Profile of Top 15 Software Exporters in Serbia, 2016

Top 15 OUTSOURCING PROFILE		NoCE	NoCF	Mark (1 min… 5 max)
Focus Area	Field of Specialization	Number of Companies with Specialization	Number of Companies with Predominant Focus	Average Mark for expertise of included NoCE
Q1 Company's business focus -business verticals	Telecom & Hightech Banking & Insurance Public & Health Energy & Utility Others	7 2 1 4 10	2 1 2	3.9 4.0 3.0 4.0 4.9
Q2 Company's business focus -horizontal business	Own product Solution Engineering: Gaming Nearshore-Software-Development	8 5 2 7	7 5 2 6	4.8 5.0 5.0 4.7
Q3 Key user	Internal Development Global Vendor Various Clients	7 2 8	6 1 5	4.7 4.0 4.6
Q4 Software Engineering	User Interface: Concept and Design Software Architecture Software development System integrations Testing Deployment	8 12 14 13 12 9	7 7 12 11 11 7	4.8 4.3 4.9 4.8 4.9 4.8
Q5 Market Geography	Local Market Regional Market International Market	4 9 11	 6 9	3.5 4.7 4.8
Q6 Company's market role (possible multiple choices)	Market lider Market developer Market follower Market niche	5 5 5 4	3 1	4.6 3.8 3.0 3.0
Q7 Company's products/ser-vices user category (type)	Truly Loyal Trapped Accessible High risk	5 3 5 2	1	4.2 4.0 4.0 4.0

Notes: Mark (1…5) – Average Mark for expertise (1 being minimum 5 being maximum)
Total number of NoCE is bigger than total number of companies (15) due to the possibility of one company to have multiple expertise.

work on that same global market. On the regional European market there are 9 companies, which shows wide nearshore software development. Only 4 companies have clients on the local market.

- [Q6] Additionally, several companies from the Top 15 made extraordinary results on highly competitive global market (SCHNEIDER ELECTRIC DMS, GTECH and NORDEUS). These companies can be freely stated as the global market leaders. It is not rare for a particular Serbian organization or individual to achieve superb results in various areas, but it is always related to the individual efforts and enthusiasm.

- [Q7] All Top 15 software exporters work in the highly competitive environment on all levels: extremely high competitiveness of IT global vendors, strong competitiveness of the regional ones and the modest competitiveness of the number of small companies worldwide. In addition, one can rarely count on "truly loyal" buyers, as there is often a presence of a wide base of "accessible" clients accustomed to having choices and ready to change both IT solutions and providers.

Potentials - Standardization of Serbian IT companies

Looking at the standardization issue from an outsourcing perspective quality management and standards/methodologies like SCRUM, CMMI, ISO 9001, ISO 27001, Six Sigma, ITIL, etc. can be assumed growing significantly in importance as foreign partners and clients´ demand is likely to increase as elaborated earlier (keywords: progressing "industrialization" of IT services and "standardization of technologies and processes"). The Serbian ICT clusters have recognized this need by including trainings on quality and standardization matters in their activity portfolio for the coming years.

Over the last few years, GIZ has been engaged in providing support to Serbian companies in introducing the necessary standards. More recently, EBRD's Business Advisory Services (BAS) Program in Serbia and SIEPA have been active in providing financial support to Serbian SMEs introducing the necessary standards. USAID has also been active in giving support to certification and training to IT companies in the Western Balkans countries. They utilized cooperation between local IT clusters and USAID's REG Project for this purpose.

There is an increase in interest for standardization in software testing, as it appears to be ever more important to foreign clients and partners of Serbian IT companies. Following this trend, Vojvodina ICT Cluster has become an exclusive partner of SEETB for ISTQB training and testing in Serbia, via partnership with Quality House, the

regional SEETB representative. In partnership with other Serbian IT clusters, the ISTQB courses and testing are now offered throughout Serbia.

Summing up the anticipated increased demand coming from outsourcing clients, and the cited examples, highlight the assumed growing demand for quality infrastructure institutions, mechanisms, and processes in the coming years.

In the IT sector, the service industry and software developers benefit from their specialization, due to their in-depth knowledge of the processes and dynamics that are each industry specific. The more specialized service-providing companies and the more specialized products are, both horizontally and vertically, the more visible success is enabled.

OUTSOURCING – Opportunities and Barriers for Serbian IT Companies

For the accomplishment of the SWOT analysis "Outsourcing – Opportunities and Barriers for Serbian IT Companies on International Markets" the following five major aspects in the identification and analysis of the opportunities and barriers have been considered:

- [A] Serbian IT Outsourcing Sector – opportunities and barriers in approaching international markets
- [B] IT Sector – general status (including all sub-sectors)
- [C] ICT R&D sector - general status of research-technological development (including high education, institutes, business, and industry sub-sectors)
- [D] ICT Higher Education - general status
- [E] ICT environment - to enable the ICT sector to be treated as one of the priorities, the Government has to create a stimulating environment for ICT development

Each aspect is examined through a SWOT analysis lens, i.e. by examining related strengths, weaknesses, opportunities, and threats.

A] Serbian IT Outsourcing Sector – opportunities and barriers in approaching international markets (1/2)

Strengths

A IT Sector in Outsourcing

- Outsourcing sector is the part of Serbian IT industry with the highest performance. All Outsourcing structural characteristics are better than those of the remaining industries
- Outsourcing will remain one of the core pillars of services sold to local and foreign clients
- Young and emerging sector with active, innovative behavior
- Good command of the English language within the sector.
- Strong capacity to adjust to new conditions and market demands
- Several great world class examples of best practice facilitate promotion
- Above average quality/price ratio of Serbian IT services
- Six well organized ICT clusters give institutional support to companies and activities in the sector

Weaknesses

A IT Sector in Outsourcing

- Low level of specialization inside SME IT companies
- Much stronger focus on outsourcing than on own solutions
- Weak focus on developing own solutions/products
- Lack of the market intelligence about international markets: insufficient specific knowledge as to what the potential markets for their goods and services could be and how to access these markets
- Lack of references and experience in getting (big) contracts
- Insufficient experience in search for international partners
- Weak focus on the more significant roles of the project
- Missing or incomplete picture of specific needs and demands of other sectors, referring to ICT products and services (inside SME IT companies)

Opportunities

A IT Sector in Outsourcing

- Potential for increasing outsourcing significantly

- Serbian Outsourcing sector is on the path of big development as it has just stepped onto the global IT scene, which is incomparably bigger than the whole present and future capacity of this sector.

- Strengthen cooperation and networking among local and international IT entities.

- Strategic shift from focus on outsourcing toward development and providing solutions, including cooperation with foreign partners

- Among the outsourcing companies, a trend of making their own products with a high export value on the foreign markets has been observed

- The knowledge, once developed and brought to a specific use, is not hard to "translate" into software product.

- Specialization and distance from the mass competition is the way for successful appearance of Serbian companies on the global market.

- Recognition of industry or other sector needs

- Geographical proximity to the European market opens outsourcing potentials

- Nearshoring - targeting the regional market and Central and Eastern Europe

- Serbian companies are to appear in two roles: vendors for regional costumers and nearshoring market for regional IT companies.

- Transfer of knowledge and experience from successful ones

- Use capacity of leading Serbian entities

- Using experts from diaspora for entering foreign markets

- The Serbian Government's plans for the development of the IT sector and setting up a range of technology parks in Belgrade, Novi Sad , Niš

Threats

A IT Sector in Outsourcing

- Brain drain of ICT professionals

- Insufficient senior programmers and other ICT experts

- Insufficient number of experienced programmers leads to disturbance on the labor market and cause a great fluctuation

- Insufficient inflow of new programmers and graduates

- Weak cooperation on ICT projects

- Command of other languages (German and French) is significantly weaker than English

- Foreign-owned companies find it easy to retreat (leave) from domestic market

- In case of any stronger global economic instability, there is a danger that a large number of IT experts move abroad, which would practically formalize the brain drain.

SWOT Analysis for (B) General status, (C) R&D and (D) Education

Strengths	Weaknesses
B IT Sector General Status	**B IT Sector General Status**
• Despite the economic, social and institutional crisis and a difficult transition process, the Serbian IT sector has survived, which proves entrepreneurial strength and vitality	• Lack of cooperation among companies, as well as other stakeholders
	• Insufficient knowledge and skills on international market penetration
C ICT R&D Sector	• Insufficient level of internationalization
• A solid number of Serbian ICT experts still remaining in the country	• Missing a public national database related to the IT sector
• Solid market orientation of ICT related institutes	**C ICT R&D Sector**
D ICT Higher Education	• Insufficient interest of academic researchers to participate in international projects
• Built ICT related education system (after the Bologna reforms)	• Low level of national funds for ICT R&D
• Solid geographical availability of faculties	• Lack of official Centers of Excellence
• Growing interest of young people in ICT studies	**D ICT Higher Education**
	• Weak or non-transparent cooperation between industry and education
	• Current demand for IT experts is significantly higher than the offer

Opportunities

B IT Sector General Status

- Work on raising the critical mass of IT experts
- Low penetration of IT within Serbian business sector makes a good market potential in the future
- Exploit the hidden potential of the SME IT sector

C ICT R&D Sector

- Rising compatibility with international ICT R&D sector
- Already noticeable improvement in exploiting the hidden potential of the ICT business sector
- Solid expertise in particular HORIZON 2020-ICT areas
- Positive attitude towards HORIZON 2020-ICT

D ICT Higher Education

- Harmonization of Serbian education system with economy (market) needs
- Increase enrollment quotas. Investments in IT education need to be increased as soon as possible
- Number of certificates and the number of IT certified experts is going to rise significantly

E ICT Environment

- EU integration of Serbia will have a positive impact on the ICT sector
- ICT is recognized as one of the key sectors by the Government, line ministries and international development organizations
- Ambitious plans expressed in strategy papers in the ICT R&D field
- Serbia as a natural gathering and coordinating regional center for West Balkan countries
- Now, the Government focuses on cooperation with domestic companies which have already been successful on International markets
- Trust domestic companies with future large state procurements of IT solutions and software.
- Establishing encouraging environment and eco system in which domestic companies could create more added value in Serbia
- Investment – big amounts or smaller ones, but continual over a longer period (several years)
- Strong role of the ICT sector in the coming Smart Specialization Strategy for Serbia

Threats

B IT Sector General Status

- Insufficient ICT demand (in period of economic crisis)
- Great inflow of foreign IT companies might seriously hamper the existing IT labor market
- Foreign solutions are bought instead of domestic ones
- Possible negative scenario and consequences of the strong focus on export, while at the same time domestic IT needs are neglected
- Modernization of economy and society requires around 20,000 IT experts, while at present less than 5,000 of them are engaged

C ICT R&D Sector

- Serbia as a latecomer to the international ICT R&D scene (since 2001)

D ICT Higher Education

- The demography of Serbia is not favorable, so the question of good measure and maximum reach of education of IT experts becomes essential
- Lack of problem solving skills and entrepreneurial spirit, excessive theoretical knowledge and inadequate general and specific technical skills
- Weak actions to decrease brain drain
- Growing lack of qualified teaching staff

E ICT Environment

- Financial crisis and other instabilities at targeted international and domestic markets
- Still present political instability in the country/region
- Uncertain sources of funding
- Mistrust in the promises of the policy makers
- Stereotypical image of Serbia on the international level
- Weak communication of the ICT sector with the policy creators
- Insufficient Government support for ICT development (weak political will, expertise and financial resources)
- Promoting Serbia as a cheap labor destination

APPENDIX
Terminology

ICT Products

According to the OECD definition, broad level categories for ICT products are: (1) Computers and peripheral equipment; (2) Communication equipment; (3) Consumer electronic equipment; (4) Miscellaneous ICT components and goods; (5) Manufacturing services for ICT equipment; (6) Business and productivity software and licensing services; (7) Information technology consultancy and services; (8) Telecommunications services; (9) Leasing or rental services for ICT equipment and (10) Other ICT services.

IT Market Structure

IT market is typically divided into three components: IT hardware, software and IT services.

ICT Market Value

IT market value (expressed in Euros) is defined as end-user (household and business) spending on IT hardware, IT services and packaged software.

Telecommunication Market Value

Telecommunication Market Value (expressed in Euros) is defined as end-user (household and business) spending on telecom equipment and telecom services. This includes the Internet market.

ICT Investment

ICT investment is only a subset of ICT products (since it reflects only the expenditure on ICT products that obey the rules on investment of the basic system of national accounts or SNA). Expenditure on rental of office machinery (which is part of the ICT sector) will normally not be recorded as investment. In practice, ICT investment is typically divided into three components: IT equipment, communications equipment, and software. These components represent the subset of ICT products that can usually be capitalized.

Revenue

In business, revenue is income that a company receives from its normal business activities, usually from the sale of goods and services to customers. In many countries, such as the United Kingdom, revenue is referred to as turnover.

Added Value = Price at which the product/service is sold – the cost of producing the product

Added Value can also be defined as the difference between a particular product's final selling price and the direct and the indirect input used in making that particular product.

Net Assets

Net assets, sometimes referred to as net worth, is the shareholders' equity = assets minus liabilities.

For a company, total assets minus total liabilities. Net worth is an important determinant of the value of a company, considering it is primarily composed of all the money that has been invested since its inception, as well as the retained earnings for the duration of its operation. Net worth can be used to determine creditworthiness because it gives a snapshot of the company's investment history. It is also called owner's equity, shareholders' equity, or net assets.

Assets

Any item of economic value owned by corporation (or an individual), especially that which could be converted to cash. Examples are cash, securities, accounts receivable, inventory, office equipment, real estate, a car, and other property.

ICT Sector

The ICT sector is defined according to the OECD (WPIIS) definition, first released in 1998 and revised slightly in 2002. It was revised again in 2007 (ISIC Rev. 4).

The four constituent sub-sectors i.e. set of companies focused on: PC hardware, Software, IT Services and IT Channels/Distribution. The starting point for the structural analysis is the official NACE registration of ICT companies, given in the table above.

Table 22: OECD ICT Sector Definition

ICT manufacturing industries	IT	ICT industry Sector
2610 Manufacture of electronic components and boards	C	
2620 Manufacture of computers and peripheral equipment	Y	IT: PC Hardware
2630 Manufacture of communication equipment	C	Telco: Hardware
2640 Manufacture of consumer electronics	C	
2680 Manufacture of magnetic and optical media	C	
ICT software and services	**IT**	**ICT industry Sector**
4651 Wholesale of computers, computer peripheral equipment and software	Y	IT: Channels - Wholesale and retail
4652 Wholesale of electronic and telecommunications equipment and parts	C	Telco: Channels
5820 Software publishing	Y	IT: Software
61 Telecommunications	C	Telco: Carrier
62 Computer programming, consultancy and related activities	Y	IT: Services & Software
631 Data processing, hosting and related activities; Web portals	C	Telco: Internet
951 Repair of computers and communication equipment	Y	IT: services

Legend: Y – IT Industry C - IT Converged industry

IT Company Size

The enterprise size categorization due to the number of their employees, size-class according to EUROSTAT Standard is following: (a) Micro company – up to 9 employees; (b) Small company – 10-49 employees; (c) Medium – 50-249 and (d) Big company – 250 and more employees.

Outsourcing

The term outsourcing is used inconsistently but usually involves the contracting out of a business function - commonly one previously performed in-house - to an external provider. In this sense, two organizations may enter into a contractual agreement involving an exchange of services and payments.

Outsourcing - Offshoring

Offshoring involves shifting work to a foreign, distant organization in order to reduce production costs.

Outsourcing - Nearshoring

Nearshoring is a derivative of the business term offshoring. Nearshoring is "the transfer of business or IT processes to companies in a nearby country, often sharing a border with your own country", where both parties expect to benefit from one or more of the following dimensions of proximity: geographic, temporal (time zone), cultural, linguistic, economic, political, or historical linkages. The service work that is being sourced may be a business process or software development.

Business Sector

A business (also known as enterprise or firm) is an organization engaged in the trade of goods, services, or both to consumers. Businesses are predominant in capitalist economies, where most of them are privately owned and administered to earn profit to increase the wealth of their owners

Non-financial industry

Industry which does not deal with financial or investment-related goods or services.

ICT education

OAS: Tertiary-type A education. Programs (ISCED 5A) are largely theory-based and are designed to provide sufficient qualifications for entry to advanced research programs and professions with high skill requirements, such as medicine, dentistry, or architecture. Tertiary- type A programs have a minimum cumulative theoretical duration (at tertiary level) of three years' full-time equivalent although they typically last four or more years. These programs are not exclusively offered at universities. Conversely, not all university programs meet the criteria to be classified as tertiary-type A. Tertiary-type A programs include second degree programs like the American Master.

OSS: Tertiary-type B education. Programs (ISCED 5B) are typically shorter than those of tertiary-type A and focus on practical, technical, or occupational skills for direct entry into the labor market, although some theoretical foundations may be covered in the respective programs. They have a minimum duration of two years full-time equivalent at the tertiary level.

Advanced Research Qualifications. Tertiary programs that lead directly to the award of an advanced research qualification, e.g. Ph.D. The theoretical duration of these programs is three years full-time in most countries (for a cumulative total of at least seven years full-time at the tertiary level), although the actual enrolment time is typically longer. The programs are devoted to advanced study and original research.

Abbreviations

AC	Associated Countries, i.e. Serbia, Switzerland, Israel, Norway, Iceland, Croatia, Macedonia, Montenegro, Liechtenstein, Albania, Turkey
CAGR	Compound annual growth rate
CMMI	Capability Maturity Model Integration
CoE	Center of Excellence
CORDIS	Community Research and Development Information Service
CRM	Customer Relationship Management
DAS	Diplomske akademske studije (Graduate Academic studies - Masters)
DED	Deutscher Entwicklungsdienst (DED) gGmbH
DS	Doktorske studije (PhD studies)
EIB	European Investment Bank
ERP	Enterprise Resource Planning
ETF	Elektrotehnički Fakultet Belgrade (School of Electrical Engineering in Belgrade)
EU	27 member states of European Union (EU27)
EU10	10 new members states which joined the EU in 2004
EU15	15 members states which joined the EU before 2004
FDI	Foreign Direct Investments
FP6, FP7	Framework Program 6, Framework Program 7
FTE	Full Time Employed Researchers
GCI	Global Competitiveness Index
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
H2020	Horizon 2020
ICT	Information and Communication Technologies
ICT-R&D	Information and Communications Technology Research and Technology Development
IDI	ICT Development Index
IMP	Institute Mihajlo Pupin
IPA	Instrument for Pre-Accession
ISIC	International Standard Industrial Classification
ISTQB	International Software Testing Qualification Board
IT	Information Technologies
LEIT	Leadership in Enabling and Industrial Technologies

MoSTD	Ministry of Science and Technology Development of the Republic of Serbia
MoTIS	Ministry of Telecommunications and Information Society of the Republic of Serbia
NACE	Statistical classification of economic activities in the European Community
NBS	National Bank of Serbia
NITIA	National Information Technology and Internet Agency
NoCE	Number of Companies with expertise
NoCF	Number of Companies with maximum focus and expertise
NRI	Network Readiness Index
OECD	Organization of Economic Co-operation and Development
OSS	Osnovne strukovne studije (Basic Vocational studies)
OAS	Osnovne akademske studije (Bachelor Academic studies)
RTD	Research and Technology Development
RATEL	Republic Agency for Electronic Communication
SAS	Specijalističke akademske studije (Specialist Academic studies)
SBRA	(or APR) Serbian Business Registers Agency

SCoC	Serbian Chamber of Commerce
SCRUM	Agile software development methodology
SPEA	Serbian Private Equity Association
SEE	South East Europe
SEETB	South East Europe Testing Board
SIEPA	Serbia Investment and Employment Promotion Agency
SITO	Serbian IT Observer
SME	Small and Medium-sized Enterprises
SORS	(or RZS) Statistical Office of the Republic of Serbia
SSS	Specijalističke strukovne studije (Specialist Vocational studies)
SWOT	S-Strengths, W-Weaknesses, O-Opportunities, T-Threats
VOICT	Vojvodina ICT Cluster
VoIP	Voice over Internet Protocol

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VOJVODINA
ICT CLUSTER

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Покрајински секретаријат за привреду и туризам

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