

ICT case study in Serbia:

Report on the innovation potential of the software industry in Serbia

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List of abbreviations

AI - Artificial Intelligence

CAGR - Compound annual growth rate

ETF - Faculty of Electrical Engineering

EU – European Union

FON – Faculty of Organisational Sciences

FP – Framework Programme

GDP – Gross Domestic Product

HR – Human resources

ICT - Information and communications technology

IF – Innovation Fund

IMP - Institute Mihajlo Pupin

IoT - Internet of things

IPA – Instrument for Pre-Accession Assistance

IPR - Intellectual property rights

IT - Information technology

MOESTD - Ministry of education, science and technological development

NACE - Statistical Classification of Economic Activities in the European Community

NBS – National Bank of Serbia

NL – The Netherlands

PMF - Faculty of Natural Sciences and Mathematics

R&D – Research and development

RS – Republic of Serbia

SME - Small and medium-sized enterprises

SW - Software

SwE – Software Engineering

UX/UI - User Experience/ User interface

VC – Venture capital

EXECUTIVE SUMMARY

In recent years, the ICT sector in Serbia has been becoming the most attractive sector of the economy. Rapid development and promotion of IT services, especially in the field of Internet and mobile technologies, application development, and outsourcing, is evident. As the global IT market continues to evolve, the needs for outsourcing jobs are rising. Serbia is geographically well positioned to provide financially viable and reliable alternatives to already developed markets. The software industry in Serbia is characterized by a high number of SMEs and freelancers, while the number of big companies is negligible. Nevertheless, the number of large companies in Serbia has been increasing since the beginning of 21st century. Some of these companies have more than one thousand employees and several hundreds of software specialists.

The main research objective of this study was to identify main strengths and challenges of the software sector in Serbia, its main sub-specializations, the compositions of the national value chain/network, future development trends, level of internationalization as well as possible directions of innovative development. The results of the study provide suggestions for policy-makers in Serbia for evaluating the current state of the software industry in Serbia, planning future activities and stakeholder dialogues and the development of Research and Innovation Strategy for Smart Specialization (RIS3).

Two methodological approaches were utilised in carrying out the ICT case study. The first was conduction of a survey on a sample of 195 software companies operating in Serbia. Secondly, the survey results were further complemented by the relevant stakeholders' views on the identification of key attributes, innovation and growth constraints, key drivers of innovation and business and technological trends in the software industry. Interviews were conducted with the main stakeholders from the following groups: managers of the major companies; leading researchers; government officials; business organizations and other supporting organisations.

The composition of the Serbian software sector

The most of the companies from software sector in Serbia are located in the two most developed regions in Serbia: Belgrade and Vojvodina. More than 90% of surveyed companies are in private ownership and are engaged in the consultancy and related activities, data processing, hosting, web portals, software publishing and other information service activities. Almost half of them have total annual revenue up to 50.000 EUR.

Total number of employees in the software sector in Serbia in period 2013-2017 shows an upward trend. In a 5-year period, employment has increased for 56.92%. Around 84% of employees in this sector are with a university degree and more than 80% of them are working on software development. The increasing trend of the IT software industry and high demand for employees are reflected in the respondents' plans for the next year, according to which they estimated an increase of the number of employees by 13% until the end of 2018. The most used programme languages and applications by software companies in Serbia are Java, JavaScript, PHP, C# and Delphi.

Cooperation with R&D sector in the country is on a very low level since only one third of companies have any kind of collaboration with this sector. Although they don't cooperate with R&D sector, more than 60% of companies realize their own research and development and more than 70% of companies have introduced innovations in the last 7 years. The level of networking through clusters is also on low level, only 36% of companies are the members of any cluster in the country.

The main strengths of the ICT sector in Serbia

The significant growth of the software sector in Serbia in the last decade led to the fact that this sector has become one of the strongest sectors in Serbia. The following major aspects in the identification and analysis of the main strengths of software industry in Serbia have been considered:

- Education and Human Resources
- Performance

Education and Human Resources

With regard to education and human resources, the following strengths of software sector have been identified by survey and questionnaire respondents:

- well educated researchers and software professionals
- highly qualified, motivated and innovative workforce
- good engineering skills and mindset
- cultural similarity with Western countries
- lower labour cost as competitive advantage compared to EU countries
- good command of English language within the sector
- Overall innovative potential, technological knowledge and good education, concentrated in and around major university centres.

Performance

Political stability and economic growth of Serbia as a country in the final phases of accession to EU and recognition and substantial support of Government of Serbia for the IT sector at the highest level (both political and financial support) has enabled this sector to develop in the desired direction. With regard to performance, the following strengths of software sector have been identified by respondents:

- exceptional and prolonged growth of Serbia's ICT sector (10-20% annual growth over a period of 10 years) makes this sector the absolute leader in Serbia's economy
- relatively low price of doing business in Serbia as compared to EU member states,
- small size of IT software companies allows easier transition into agile/collaborative mode of support to their end users
- Potential for growth - Serbian ICT sector is still far from the saturation point
- capability of producing the top-quality and highly innovative software solutions, as well as all necessary services, know-how, and applied research capabilities
- proximity and time zone in line with almost all EU member states

The process of remarkable growth of Serbia's software industry has already started. In order to enable further growth of the sector, Government needs to feed it adequately and consistently in the future period by conducting the following measures:

- significantly enlarge quotas for software engineering at public universities; increase the number of students who will become IT professionals through support of formal and non-formal education,
- introduce more advanced university programs for cutting edge technologies (big data, AI),
- finding solution for high school education and rising lack of teachers,
- further investments in education system and stronger support to start-up and SME community, especially among young people; developing sponsorship and recruitment programs,
- developing a growing number of infrastructure organizations to support innovation,
- improving the law on higher education which allows people from industry to influence changes in the curriculum,
- institutionalizing and strengthening existing support for ICT by top level decision makers and building similar types of support at municipality levels,
- building on successes and continuing the overall process of increasing the ease of doing business in Serbia,
- strengthening financial instruments available to start-ups, particularly to new businesses with high added value for a society,
- substantially strengthening the innovation process (venture capital, angel investors, use of EU structural funds, joint projects of foreign and domestic ICT companies with leading research institutions in Serbia, setting up of strategic public-private partnerships)
- promoting of the start-up concept among young people,
- improving of the regulatory framework, removing the road blocks from the legislative point of view

The most important challenges of the ICT sector

Lack of skilled labour on the market and risk of fluctuation of IT experts are the most important challenges of software industry in Serbia. Software sector is growing faster than the capacities of the educational institutions can respond to the demand for qualifications. In addition to insufficient supply of qualified people and the lack of applicable knowledge, surveyed respondents also highlighted the following challenges:

- increasing trend of labour costs due to freelancing and outsourcing,
- unfair tax system (taxation of a marketing budget that exceeds 10% of revenue; high contributions to salaries; Ireland, for example, was very successful in luring multinational corporations with tax breaks. Ireland takes 2% from profit and in Serbia it is 15%, that is why some domestic companies are registered there; taxation of members of the joint stock company in RS is 15% and in Bosnia 0% etc.),
- financial regulatory framework – (legislation and online payment - for online payments only dinars can be obtained; impossibility to publish new products on Google / App Store from Serbia etc.),

- brain drain (young people very often leave not due to inadequate salaries, but due to low quality of life and overall corruption),
- the major scientific equipment (e.g., supercomputers, data centers, grids), knowledge-based resources (e.g. archives, databases), computing, software and communication infrastructure are insufficient or lacking,
- weak marketing sector within the companies

Subsectors/parts of the value chain present in the country

There is a good programmer base in Serbia, however in order to excel in product development it is necessary to educate and train people how to develop new features, how to test them, how to interview users, how to identify potential improvement points, and it is necessary to increase capacities in marketing. Outsourcing business model is the most prevalent business model in this sector. IPR mostly does not stay in Serbia, with rare exceptions.

The growth of the software industry in Serbia is mainly based on exports to global markets. Comparison to projects for foreign customers, very few products and services are developed for the Serbian market. In the software development value chain, companies from Serbia are engaged in all activities of the value chain. However the majority of them are engaged in low value-added activities meaning that contact with the end-user is not necessary. More than 70 percent of surveyed companies basically draw on codified programming skills; while about 50 percent respectively work in the more demanding areas of requirements analysis and high-level design.

There is still high number of software companies have been competing globally on the basis of the lower price. This growth model is now in danger since the salaries in the sector grow and the advantage of the salary is becoming less important. The growth of the software industry in the countries of the region puts additional pressure on domestic companies to change the business model. The alternative for the software sector in Serbia seems to be to move to activities with higher added-value and start competing on the basis of innovation. Based on the current state and dynamics that has existed for several years, it is clear that in the coming period, outsourcing will be the prevailing business model of most companies in the software sector. The role of the state in this process is to support companies that develop their own solutions and thus motivate companies to change their business model.

Dynamics of the sector and role of start-up companies

ICT is the most mobile and adaptable business sector. It immediately adapts to relative advantages in the market, labor force, business environment, as well as the capacities of the relevant research, development and innovation institutions. This mobility was the principle reason why the software sector has made such a strong foothold in Serbia in a relatively short time. That same mobility can become a principle challenge if the sector is not analysed and supported from the government level up to regional, European and global levels (e.g. West Balkans, Balkans,

Danube Region, South East Europe, European Union, strategic partners and markets at global level) and in the opposite direction down to intra-country regions, cities and municipalities.

The software industry in Serbia has changed significantly in the last decade, and its boundaries have become unpredictable as software has become a key facilitating technology in many other industries. Employment in this sector is growing at an incredible pace and interviewed stakeholders projected to be the fastest growing sector of the economy in the next period. The business model of most software companies is changing from outsourcing and simple programming services, which were mainly present in the first decade of 21st century, to developing their own solutions/products. In the period 2010 to 2015, total turnover and number of employees in the software industry has more than doubled, which underscores the emerging character of this sector in Serbia.

This is the most dynamic sector with a lot of new innovative start-ups which role is crucial in the overall development of the sector. Start-up culture in Serbia is improving since the number of start-up companies increases. As more information is accumulated regarding the sector it becomes more apparent that there is an exceptionally large number of extremely small ICT companies that are still unaccounted for. Almost all information about the sector is coming from the larger companies, but the small start-ups play a crucial role - both together form a stronger ecosystem.

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

Future trends significant for the development of the sector

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

Based on survey respondents' reflection for the upcoming period, it can be concluded that the software industry will continue to expand. Penetration into new markets and development of new products/services on the domestic and foreign market are the next steps indicated by the large number of companies. Many foreign ICT companies already established their branches in Serbia attracted by highly qualified and well educated young personnel and there is a trend of raising interest for this area. Due to raising salaries and costs in Serbia for software professionals, local companies which are presented only on domestic market will have hard time improving themselves in professional terms, since they will have to give almost European salaries to local IT professionals.

Further development of ICT in Serbia will strongly influence - and be strongly influenced by - the following processes:

- Efficient functioning (of enterprises, government, large infrastructures)
- Digitalization (cultural heritage)
- Logistics (public procurement, transport, pharmaceuticals, defence)
- Data Science
- Data Security
- Virtualization of goods
- IoT - Internet of things
- Robotics
- AI - Artificial Intelligence
- Machine Learning
- GPU and other hardware accelerators
- Distributed computing infrastructures
- New parallel programming languages
- 3D modeling
- Virtual Reality
- Embedded Systems
- Smart-Grid Systems

Niche markets will grow around existing expertise:

- gaming, entertainment and media,
- efficient management of large infrastructure networks (big data, distributed data systems),
- supercomputing (modelling of complex systems, visualization),
- smart printing,
- development of next-generation encryption technologies,
- sector-wide integration built around data acquisition and management (particularly in agriculture, health and environmental applications),
- robotics

Competitiveness at the international level and the level of internationalisation

Serbian software sector is capable of producing competitive ICT solutions, recognized all over the world. Individuals and enterprises from Serbia are still not purchasing knowledge on the global market and investing it into national economy. The opposite process is slowly becoming visible – international companies are starting to identify and buy existing local knowledge and expertise. Domestic companies are not always aware of local knowledge, skills and expertise that is globally competitive and more easily accessible. The level of internalization is high, since the vast majority of IT companies in Serbia are either branch offices of foreign companies, or domestic companies that use outsourcing business models (develop solutions for foreign clients):

- Some of well-known companies have established their development centers here (e.g., Microsoft);
- Some of successful domestic enterprises are acquired by foreign companies (e.g., DMS);

- There are examples of fast growing companies that are influential abroad in its area of competence (e.g. Nordeus, ProSense);
- There are also a number of companies and even individuals included in software and hardware outsourcing business.

Survey results have shown that half of the companies from the sample have formal contractual relationship with their partners from abroad. Joint venture and Licence agreement are the most common forms of cooperation with foreign partners. More than 57% of companies in software industry have sales abroad, among which, about 50% of companies have total income from sales abroad up to 50.000 EUR. The competitive advantage of main products/services of software companies are based on good quality and satisfied need of new users.

According to the results of survey, the most important factors for positioning Serbian software companies on international market are:

- good quality of the products and services
- specialized expertise in the field,
- previously acquired reputation, and
- programming skills

Poor marketing, small offer and lack of qualified labour are the most important diminishing factors of competitive position on international market.

Drivers and Barriers of Innovation

The most of companies operating in this sector do not deal with the intellectual property rights. In the case of software contracts, generally, there is no comprehensive understanding of the intellectual assets generated in software development outsourcing and the related IPR involved and the contingency factors that determine when vendors are more likely to obtain IPR from clients. General explanation for this trend is that new software solutions are rapidly developing and applying, which makes difficult to protect them in the form of patents. At the same time, it prevents the competition from copying them completely. In addition, for the realization of the projects, it is not enough to have software; the basic problem is its practical application in real control centres, its integration with the existing components and its adjustment to the specific requirements of users and maintenance.

Software innovation is often driven by user need and expectations. According to the respondents' observations, key drivers for innovation in Serbian software sector could be summarised into the following:

- Market needs and market opportunities simultaneously taking into account "science push" and "market pull" factors. The need for innovation comes from analysis of the existing market and potential needs and necessity to adapt to market changes.
- Client's needs and requests - Rising customer expectations regarding service and quality. Recognizing the needs that users have and solving these needs on innovative ways are the important drivers for innovation. Clients have a problem or they are looking for small changes in

existing solutions, Software companies usually identify technology that can be a solution for the client's problem.

- Internal capacities within the companies and innovative ideas come from workers. Idea for innovations happens within the company very often by fostering internal competitions for new innovative solutions.
- Increased competition. Keeping pace with key competitors on the market.
- Participation in EU projects, cooperation with international partners.
- Internal estimation of business trends and technological development, world trends, examples of good practice, legislation etc.
- Cooperation with business incubators for mentoring and other assistance and membership in the clusters.

On the other side, key barriers for innovation are:

- The lack of investments, potential investors are still not active enough on the market.
- Small market and low demand on domestic market.
- Modest R&D funding in Serbia. Scientific research system is completely separated from the economy.
- Slow and expensive patenting process.
- Society is conservative, especially state administration - poor organization.
- Adoption rate – the market slowly sets out the requirements for new solutions.
- Lack of incentives for innovation from the government funds.
- Lack of capacity and high-quality personnel. Education system does not provide a sufficient number of quality personnel in the sector.
- The lack of staff.
- Insufficient cooperation with universities.
- Risk aversion.

Government actions to support the growth of the sector

The performance of companies is partially conditioned by the policies of the government. In order to achieve expansion and future development, regulations should be changed. Most important constraints for the future development opportunities indicated by the respondents are: high expenditure on taxes and contributions and unfavourable general conditions on the domestic market. With regards to concrete measures that should be introduced by government, most of the companies consider that direct support to R&D and innovation in firms and Policy on entrepreneurship would affect the companies in the next few years.

Current broadband infrastructure is unfavourable for the further development of the software sector in Serbia. The Serbian government should eliminate the interests of big players and put more efforts in order to create the better broadband infrastructure which is necessary to develop the Serbian domestic market for IT products and solutions. Government institutions are slow, inertia of the system. The way of thinking is still the same as in the former system. Better organization of administration at all government and non-government levels is indispensable.

Governance and Regulations

With regard to governance and regulations, the following measures are suggested by software companies:

- Offering more incentives
 - support to domestic entrepreneurs through incentives in employing and taxation,
 - long-term incentives, professional practice,
 - innovation incentives, incentives to create cooperation between local firms and joint output with a new product,
 - tax incentives for the whole ICT sector, especially for start-ups, contact with investment funds, business angels, etc.,
 - providing good infrastructure and access to finance (government level – policy making especially on alternative funding sources, e.g. venture capital, business angels, accelerators...)
- Improving regulatory framework
 - reduction of fiscal and parafiscal burdens,
 - better support to IT companies in terms of reducing corporate income tax, contributions to the salaries of new employees and the like,
 - removing regulatory burden,
 - freelancer status regulation,
 - e-payment regulation has to be in line with the rest of the world,
- Creating favourable conditions at the market
 - elimination of politically preferred suppliers who take projects in areas where they do not have any experience; conduct an analysis of the received tenders for the public sector,
 - reducing corruption at the highest levels and therefore reduce the impact of privileged competition, and create better conditions for smaller producers,
 - assuring proper implementation of laws

Education and Human Resources

Serbian government has already proclaimed the education and digitalization among its highest priorities. It seems that the potential impact and benefit of the improvements in the ICT sector has been recognized on the entire Serbian economy and that it should be strongly supported by increasing investments.

The survey results clearly show how the lack of skilled staff slows down the growth potentials of the software industry in Serbia. According to the survey respondents, adjusting the education system to the needs of the software industry should be a clear priority measure. Modernizing curriculum and increasing enrolment rates for IT studies are considered to be very important for the sector as well.

The government should be doing more for the IT software sector when it comes to education, particularly to increase the offer on the market by educating more IT specialists at faculties, colleges and secondary schools. The increase of students enrolling in IT studies has occurred

thanks to the rising popularity of the IT profession among young people. The current capacities of Serbian universities to accept informatics students should be dramatically increased. Even if the education system suddenly increased numbers of coders, developers, and software engineers – it would not be enough to satisfy the needs of the IT industry. Long term aim of improving academy education and creating attractive working environment is to attract professionals from abroad to come and work in Serbia. Even, to attract well-educated people from neighbouring countries to come in Serbia and continue with their professional life in Serbia. Creating more stable general economy conditions for businesses are a must for this.

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

1. Background and Objectives of the ICT Case Study

1.1 Background and Challenges for ICT Case Study in Serbia

The general aim of the ICT case study is to identify main strengths and challenges for the IT sector in Serbia, its main sub-specializations, the compositions of the national value chain/network, future development trends, and level of internationalization and possible directions of innovative development.

ICT case study in Serbia will be a useful tool for policy makers in the Serbia for numerous purposes, in particular, for evaluation of current state of software industry in Serbia, planning future activities with paying more attention to support stakeholder dialogue and the development of RIS3.

The Serbian ICT market was estimated to €1.73 billion in 2016, accounting for 6 percent of Serbia's GDP. It has been the most vibrant and fastest growing Serbian sector for the last 10 years. The Belgrade software sector contributes significantly to value added, growth and pays higher wages than elsewhere in the country. The overall role of hardware production, on the other hand, remains relatively small, although apparently characterised by a large number of smaller firms. Most software companies target international markets, much less the Serbian market.

Four key challenges have emerged that are important to sustain and help the software industry to grow. They emerged from on-going interviews and a survey of software companies in Serbia.

1. Challenge 1: How to tackle chronic lack of IT skills in conditions of ever-increasing demand?

Given the already scarce pool of well-qualified IT graduates and increased competition for the most talented, improving university education to better meet labour market demands and support to more agile informal education seem to be the only ways forward. In terms of formal education, there are improvements: increased quotas for IT-related studies, actions to provide more space at the faculties, but also making possible for professionals from the industry to be engaged as lecturers. On the informal side, more improvements are possible, especially in terms of better cooperation of IT companies and initiatives in informal education, but also government's role in these processes.

Serbia is not alone when it comes to shortage of IT skills. Across Western economies, schooling systems have failed to predict and timely response to the boom in demand for IT professionals. Swift action is needed, and exploring every possible avenue is a must, in order to at least mitigate situation – as more permanent solution escapes our vision. After years of lobbying, the Serbian IT community managed to put IT high on the agenda of the current government, and some system-wide measures are being introduced: mandatory IT education from the 5th grade of elementary school has been introduced and more focus is put on high-school students in terms of digital skills and increased quotas for IT-related studies. This allows IT professionals to be engaged in formal teaching processes, investments in physical infrastructure and in non-formal education. However,

each of these actions needs to be improved. On one side, the IT community could certainly invest efforts into unification of its demands and have common strategy for lobbying. On the other, government should invest into own resources (human and financial) to respond adequately to these demands – but primarily, to have the vision, taking care of the bigger picture and place of IT in Serbian economy and society.

2. Challenge 2: How to improve the institutional set-up to support the software industry?

The real challenge is actually twofold -- not only how can the government help IT/software industry continue its growth, but also how the IT/software industry/community can support the government and the local economy in bringing about the benefits of digital transformation.

The software industry is moving fast, making it oftentimes difficult to adapt or change the institutional framework accordingly. While the Serbian software industry is mostly export oriented, the local IT market is underdeveloped and characterized by low demand for IT products and services (and hence low spending on IT/software products and services, far below the EU averages), low level of industrial automation and application of innovative technologies, weak exchange between the academia and the industry.

The IT sector is also burdened by lack of a coherent government ICT policy, an unfinished legal framework and an unadjusted educational system. The current legal framework burdens companies and entrepreneurs with bureaucratic procedures, and does not provide adequate conditions for cross-border e-payments, application of the new business models (e.g. platform economy, fintech etc.) or access to finance (e.g. VC funds, crowdfunding etc.), while the unadjusted educational system produces an insufficient number of IT professionals with entrepreneurial skills and outlooks.

3. Challenge 3: How to strengthen intermediaries like clusters to effectively contribute to a continuous dialogue between companies, universities and government?

The Serbian software industry is very dynamic with a changing landscape. Developing a multilateral dialogue as platform for strategic and operational discussions and decisions cannot rely only on direct business participation. Representative and recognised intermediary organisations like the Chamber of Commerce, cluster organisations and the like can play an important interface function to establish a continuous dialogue between companies, universities and government.

The Serbian government is developing a new innovation strategy for smart specialisation. For this, the analytical evidence base is currently being finalised and will serve as the basis for discussions during 2018. In a series of workshops, the most relevant priority domains will be discussed and roadmaps prepared together with companies, research institutes and universities. Clusters and other intermediaries will play an important role to engage in this dialogue and sustain it.

4. Challenge 4: How to better integrate the software industry into Serbia's economy and society more broadly?

Information technologies make it possible to do things not only faster and better, but to do new things that were impossible to do without these technologies. The level of investments in IT per

capita is an excellent indicator of the development level of any country. In Serbia, that indicator stands at €62. For comparison, in EU it averages at €800. The countries which entered EU in 2004 had an average investment in IT per capita of €150. Therefore, Serbia should strive to this figure, not as a goal – but as a starting point. It would mean that this country finally shows some significant implementation of standards and good practice to be able to jump on the band wagon with the rest of the more developed European countries.

BioSense advances and integrates all that ICT can offer today – nanomaterials, low-cost miniature sensors, satellite imaging, robotics, big data analytics – to provide as much information as possible to the agricultural sector. Only recently, the Centre for Digital Agriculture of Serbia was launched to create synergies synergy between agriculture and information technologies through the development of scientific research. While most software companies target international markets, it is important to explore how existing traditional industries can be upgraded using IT solutions. For setting the scene, there is no need to invent hot water. The ingredients are well known: defining a vision and mobilizing resources, compiling strategy, deriving an action plan and – work hard to successfully use the IT sector for the benefit of the entire economy and society in Serbia.

1.2 Objectives of the ICT Case Study in Serbia

ICT case study is organised in several steps. First step is a survey and interviews of key stakeholders in the ICT sector (software) in Serbia. In the second step, the authors conducted a market analysis (export/import; products/services; human resources/skills) and described the regional distribution of software companies. The full ICT case study answers the following research questions:

- What are the main strengths of the ICT sector in Serbia that could potentially be successful at an international (niche) market?
- What needs to be done to further develop these strengths?
- What are the most important challenges to the ICT sector and how can they be overcome?
- Which subsectors/parts of the value chain are present in the country and what are the regions with their strongest presence? Are there any parts that are missing?
- Which companies are the most innovative in the sector and what success stories can be used as lessons for other companies?
- How dynamic is the sector and what is the role of start-up companies in its development?
- What are the future trends that are significant for the development of the sector?
- How competitive are the Serbian companies at the international level and is the level of internationalisation generally high or low?
- Which actions seem most important to support the growth of innovativeness and competitiveness of the sector?

In addition, research design of this study addresses the following research questions:

- What is the composition of the Serbian software sector (nature of stakeholders and their relevance)?

and

- Which factors have to be addressed by government action to support stakeholder dialogue and the development of this domain?

The research design will in detail cover the following elements:

D1. The methodological report which includes the questionnaire for software companies and definition of a representative sample for the online survey

D2. Analysis of the survey results and selection of the key types of stakeholders interviewed

D3. Interviews with main stakeholders:

- a. Managers of the major companies
- b. Leading researchers
- c. Government officials
- d. Business organizations

D4. Market analysis:

- a. Domestic
- b. Export / Import
- c. Analysis of software products / services
- d. Analysis of human resources/skills
- e. Regional distribution of software companies

D5. Any other relevant dimension

Based on case study research findings, the authors will draw conclusions how this stakeholder dialogue can be institutionalised in this domain and how a similar approach can be employed also in other domains.

2. Methodology

2.1 ICT case study design

The research design covers the following elements:

- 1) Developing and conduction survey questionnaire for software companies
- 2) Conducting interviews with main stakeholders:
 - a. Managers of the major companies
 - b. Leading researchers
 - c. Government officials
- 3) Conducting market analysis
 - a. Domestic
 - b. Export /import
 - c. Analysis of software products/services
 - d. Analysis of human resources/skills
 - e. Regional distribution of software companies

2.2 Questionnaire design and data collection

The Institute Mihajlo Pupin (IMP) was given the mandate to develop the survey frame. In consultation with Joint Research Centre, IMP has reviewed and finalized the questionnaire. The survey was designed to address the following research questions:

What is the composition of the Serbian software sector and which factors have to be addressed by government actions to support stakeholder dialogue and the development of this domain?

The target population of the survey were companies operating in software industry. The number of ICT software firms in Serbia according to Chamber of Commerce register is 1.363 (as of November 2017). The survey has been addressed to all companies in Chamber of Commerce register.

Data on ICT companies from Serbia were provided by Chamber of Commerce and Industry of Serbia. Questionnaire was delivered to the respondents through the dissemination of information about survey by email (with link to the questionnaire in Limesurvey tool hosted by IMP). Representative sample of ICT firms in Serbia was chosen by analytical team in Serbia. The survey ran from 7 November to 25 December 2017. It consisted of 45 questions and included seven main parts:

- 1) General data of the company;
- 2) Growth and competitive advantage of the company;
- 3) Strategic partnership and cooperation
- 4) Placement and Market
- 5) Quality management, Innovation and Research and Development in the company
- 6) Strategic Development Directions
- 7) Distinguishing characteristics of the Company

2.3 Interview design

Main objectives of the interviews with main stakeholders were the following:

- 1) Identify innovation and growth constraints as well as key drivers of innovation for Serbian IT SW SMEs,
- 2) Identify key attributes of IT SW companies that could benefit the most from public intervention,
- 3) Identify business and technological trends perceived by the IT SW companies.

Additional objectives are, as well:

- 4) Raise the company' awareness of the smart specialization process in Serbia,
- 5) Identify the leading IT SW companies to be invited to participate in Innovation Camp, which aim to help assess the developmental and innovation potential.

Targeted stakeholders were:

- a) Managers of the major companies
- b) Leading researchers
- c) Government officials
- d) Business organizations
- e) Supporting organisations
- f) Other stakeholders

Pre-defined interview questions for managers of the major companies are:

- 1) What are the main strengths of the ICT sector in Serbia that could potentially be successful at an international (niche) market?
- 2) What needs to be done to further develop these strengths?
- 3) What are the most important challenges to the ICT sector and how can they be overcome?
- 4) Which subsectors/parts of the value chain are present in the country and what are the regions with their strongest presence? Are there any parts that are missing?
- 5) Which companies are the most innovative in the sector and what success stories can be used as lessons for other companies?
- 6) How dynamic is the sector and what is the role of start-up companies in its development?
- 7) What are the future trends that are significant for the development of the sector?
- 8) How competitive are the Serbian companies at the international level and is the level of internationalisation generally high or low?
- 9) Which actions seem most important to support the growth of innovativeness and competitiveness of the ICT sector?
- 10) Key problems of the Serbian innovation system relevant for ICT sector – what to focus on (the most important 3 urgent actions to be launched – by whom?)

Pre-defined interview questions for leading researchers in the area of ICT-Computer programming are:

1. Performance in ICT as part of the science and innovation system in Serbia (in international comparison) - strengths, identification of weaknesses (human resources? research infrastructure? language knowledge? weak linkages with industry? etc.)
2. Main funding schemes you are familiar (national and international)? How are you satisfied with them?
3. Status of research infrastructures in ICT sector?
4. Demand for research and innovation in ICT in Serbia?
5. What are the main strengths of the ICT sector in Serbia that could potentially be successful at an international (niche) market?
6. What needs to be done to further develop these strengths?
7. What are the most important challenges to the ICT sector and how can they be overcome?
8. Which R&D organisations are the most innovative in the ICT sector and what success stories can be used as lessons for other R&D organisations?
9. What are the future trends that are significant for the development of the ICT?
10. How competitive are the Serbian R&D organisations in the ICT sector at the international level and is the level of internationalisation generally high or low?
11. Which actions seem most important to support the growth of innovativeness and competitiveness of the ICT sector?

Pre-defined interview questions for government officials responsible for governance of ICT-Computer programming In Serbia are:

1. Demand for research and innovation in ICT in Serbia?
2. Financing innovation (role of own sources, public financing – which actual schemes are available for you or use, international sources)
3. Regional distribution of research and innovation resources, capacities and activities
4. Tools and ways of coordination in the government (vertical and horizontal coordination)
5. Share of responsibilities among main actors in governments on innovation policy setting and implementation
6. Strategies under planning
7. Framework conditions of innovation in ICT sector in Serbia (competition, intellectual property rights, entrepreneurship and administrative burden, taxation)
8. What are the main strengths of the ICT sector in Serbia that could potentially be successful at an international (niche) market?
9. What needs to be done to further develop these strengths?
10. What are the most important challenges to the ICT sector and how can they be overcome?
11. Which subsectors/parts of the value chain are present in the country and what are the regions with their strongest presence? Are there any parts that are missing?
12. How competitive are the Serbian companies at the international level and is the level of internationalisation generally high or low?
13. Which actions seem most important to support the growth of innovativeness and competitiveness of the ICT sector?
14. Key problems of the Serbian innovation system relevant for ICT sector – what to focus on (the most important 3 urgent actions to be launched – by whom?)

Topics related to interview objectives in business organizations are:

- 1) Introduction (max 15 min.):
 - General data about the company [just briefly]
 - Business model of the company (products/services etc.)
- 2) Main Part - Innovation (30 min)
 - Generally about innovation in company (product / service / process / marketing / organization; incremental / radical)
 - Drivers for innovation
 - Barriers for innovation
 - Inputs for innovation
 - o Networking/collaboration for innovation research/business etc.
 - o Use of IPRs
 - o Financial inputs
 - o Competence Management
- 3) Addition to the main part - Policy incentives/support for innovation (5-10 min)
- 4) Outlook - Business and technological trends (5-10 min)

Pre-defined interview questions for managers of the major organisations established to support functioning of the ICT-Computer programming in Serbia are:

1. What are the main strengths of the ICT sector in Serbia that could potentially be successful at an international (niche) market?
2. What needs to be done to further develop these strengths?
3. What are the most important challenges to the ICT sector and how can they be overcome?
4. Which subsectors/parts of the value chain are present in the country and what are the regions with their strongest presence? Are there any parts that are missing?
5. Which companies are the most innovative in the sector and what success stories can be used as lessons for other companies?
6. How dynamic is the sector and what is the role of start-up companies in its development?
7. What are the future trends that are significant for the development of the sector?
8. How competitive are the Serbian companies at the international level and is the level of internationalisation generally high or low?
9. Which actions seem most important to support the growth of innovativeness and competitiveness of the ICT sector?
10. Collaboration with R&D sector?
11. Key problems of the Serbian innovation system relevant for ICT sector – what to focus on (the most important 3 urgent actions to be launched – by whom?)

Pre-defined interview questions for interviews with other stakeholders who are in direct or indirect relationship with companies in ICT – Software programming sector in Serbia are:

1. Main data
2. What are the most important challenges to the ICT sector and how can they be overcome?

2.4 Data Analysis

The data collected were analysed to obtain usable and useful information gathered by the survey questionnaire. The main purpose of data analysis that covered qualitative or quantitative data, is to: describe and summarize the data; identify relationships between variables; compare variables; identify the difference between variables and forecast outcomes.

The statistical data analyses used for ICT case study are descriptive statistics. Data analysis started with cleaning and organizing the data for analysis (data preparation) and then, with a simple description of all case study variables. The analysis of the survey data consisted of constructing frequency and coverage statistics along several dimensions and various characteristics of the surveyed companies. The relationships between variables were verified using cross-tabulations of discrete variables and distribution comparisons for continuous variables. Within the descriptive statistics, univariate analysis has been used in order to examine major characteristics of variables, particularly: the distribution, central tendency and the dispersion of variables. In addition to descriptive analysis, other statistical test has been used (One-way ANOVA) to compare the means between the ICT sector companies operating in different regions in Serbia in order to determine whether any of those means are statistically significantly different from each other.

3. Main Findings I – Survey questionnaire for software companies

The target population of the survey were companies operating in the ICT (Software) sector in Serbia. Data on software companies from Serbia were provided by Chamber of Commerce and Industry of Serbia. A call for completing the questionnaire was sent to 1.089 companies, out of which 195 companies responded to the questionnaire, which makes about 18% of the response rate. After purifying the results, the total number of companies which responses were analysed is 56 (quality of replies was acceptable for analysis), and this is one third of the responding companies (28.72%). In this paragraph, the results of the questionnaire will be presented.

3.1 General data of the company

3.1.1 Companies Information

The most of the companies from the sample are operating in the two most developed regions in Serbia: Belgrade and Vojvodina. The largest number of companies is coming from Belgrade region, nearly 50%. More than 30% of companies are operating in Vojvodina and the 20% are from other two regions: Šumadija and Western Serbia and South and East Serbia. More than 90% of companies are in private ownership.

Almost half of the sample is covered by the companies that are on the market more than 10 years. 7% of sample is young companies from 1-3 years old.

Table 1: Distribution of companies by age and region of operating (%)

Characteristics		Total (%)
Age of the company	1–3	7.8
	4–7	13.7
	7–10	31.4
	More than 10	47.1
Region	Belgrade	49.0
	Vojvodina	30.6
	Šumadija and Western Serbia	10.2
	South and East Serbia	10.2
Ownership	Private	94.6
	State	5.4

Source: Own calculations based on data from survey.

3.1.2 Field of activity

Regarding the NACE Rev. 2 classification of economic activities the most of the companies are working in the field of computer programming, consultancy and related activities (more than 60%), form 20 to 25% of companies are represented in the field of data processing, hosting and related activities; web portals; software publishing and other information service activities (Table 2).

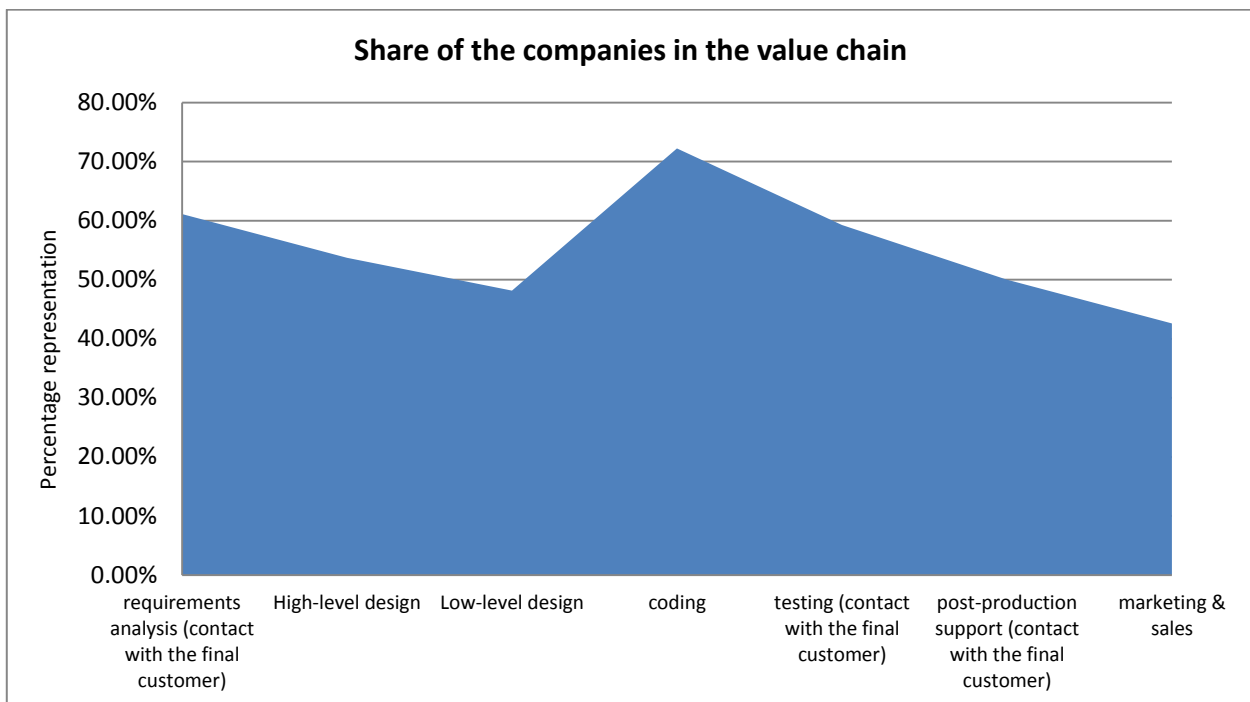
Table 2: Distribution of companies by NACE Rev. 2 classification of economic activities (%)

NACE Rev. 2 classification of economic activities	Total (%)
Computer programming, consultancy and related activities	60,94%
Data processing, hosting and related activities; web portals	25,00%
Software publishing	21,88%
Other information service activities	21,88%
Management consulting	14,06%
Advertising	7,81%
Other professional, scientific and technical activities	7,81%

Source: Own calculations based on data from survey.

Figure 1 shows the representation of the companies within the software value chain. In the software development value chain, companies from Serbia are engaged in all activities of the value chain. However the majority of them are engaged in low value-added activities meaning that contact with the end-user is not necessary. More than 70 percent of surveyed companies basically draw on codified programming skills; while more than 50 percent respectively also work in the more demanding areas of requirements analysis and high-level design.

Figure 1: Position of the companies in the value chain



Source: Own calculations based on data from survey.

Majority of companies operating in this sector are start-ups with good innovation and development potential. Questionnaire results have shown that more than 65 percent of companies are small companies up to 10 employees (Table 3).

Table 3: Distribution of companies by size (%)

Type and size of companies	Total Share (%)
SME <= 10	65,12%
SME 11-49	20,93%
SME 50 – 249	9,30%

Source: Own calculations based on data from survey.

Total number of employees in the software sector in Serbia in period 2013-2017 shows an upward trend. In a 5-year period, employment has increased for 56.92%. 84.27% of employees are with a university degree and more than 80% of them are working on software development. The growth trend of the software industry sector and high demand for employees are also reflected in the respondents' plans for the next year, according to which they estimated increase of the number of employees by 13% at the end of 2018.

The most used programme languages and applications are Java, JavaScript, PHP, C# and Delphi (Table 4). More than 90% of companies have modern equipment.

Table 4: Programme languages used by companies (%)

Programme languages and applications	Total (%)
Java	36,36%
JavaScript	30,30%
PHP	24,24%
C#	18,18%
Delphi	18,18%
PI/SQL	15,15%
.NET	15,15%
Visual Studio	15,15%
Python	15,15%
C++	12,12%
HTML5	9,09%
Angular 2	9,09%
CSS	6,06%
Eclipse	6,06%
Android	6,06%
Firebird SQL	6,06%
Node.js	6,06%

Source: Own calculations based on data from survey.

3.2 Growth and competitive advantage of the companies

3.2.1 Total annual revenue of the companies

Serbian market is apparently characterised by a large number of smaller firms. Almost half of the companies from the sample have total annual revenue up to 50.000 EUR (Table 5). On the other side, there are also some large companies which are competitive on the global market.

Table 5: Distribution of companies by annual revenue (%)

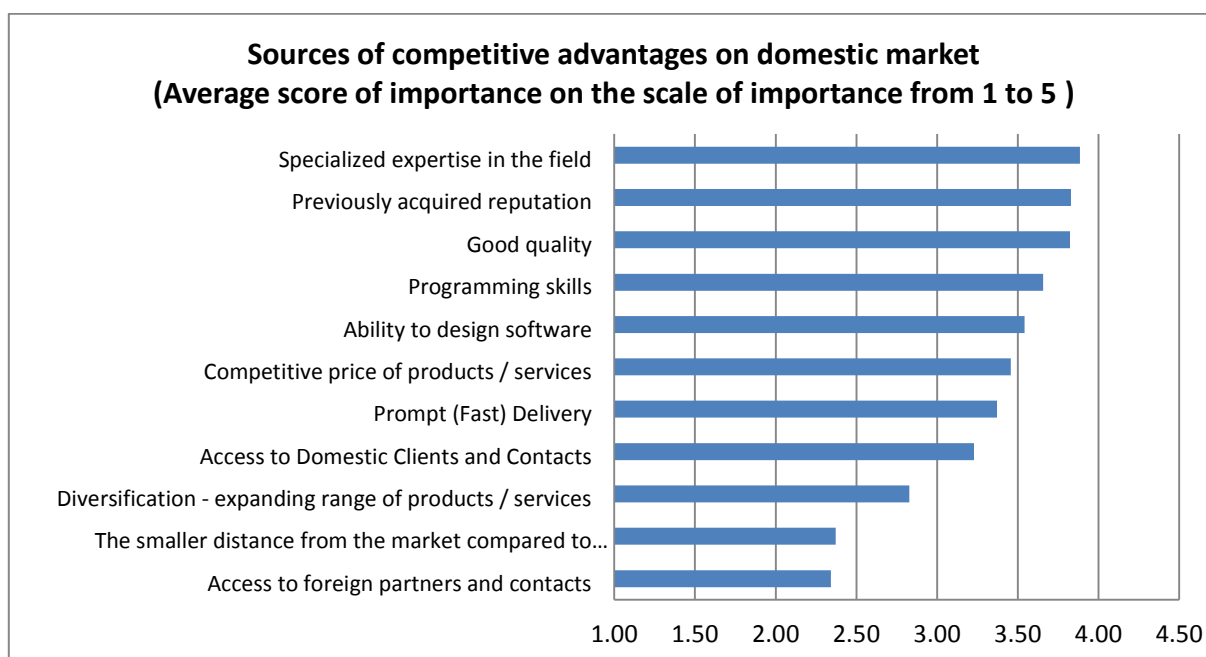
Total annual revenue	Total (%)
0-50,000 EUR	46,15
50,000 – 150,000 EUR	17,95
150,000- 500,000 EUR	7,69
500,000 – 1 million EUR	5,13
1 million -3 million EUR	12,82
More than 3 million EUR	10,26

Source: Own calculations based on data from survey.

3.2.2 Competitive position on the domestic market

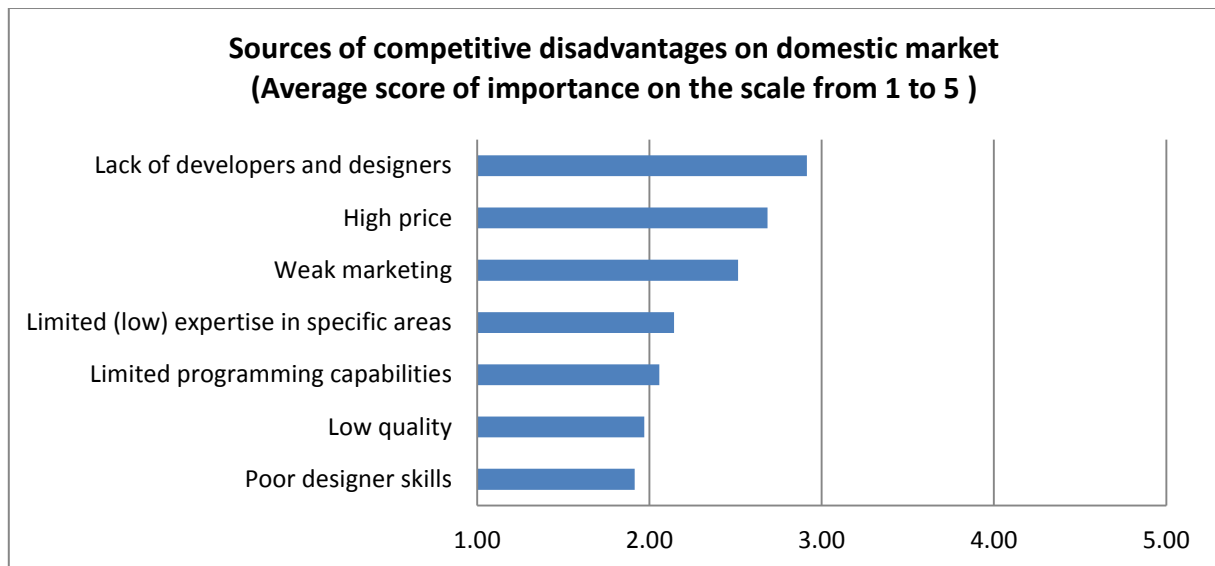
The most important sources of competitive position of companies in ICT software industry in Serbia are: specialized expertise in the field, previously acquired reputation and good quality of products and services provided.

Figure 2: Importance of sources of competitive advantages on the domestic market



Lack of developers and designers is the most important disadvantage on the domestic market (Figure 3). Lack of skilled labour on the market and risk of fluctuation of IT experts are the most important challenges of Software industry in Serbia.

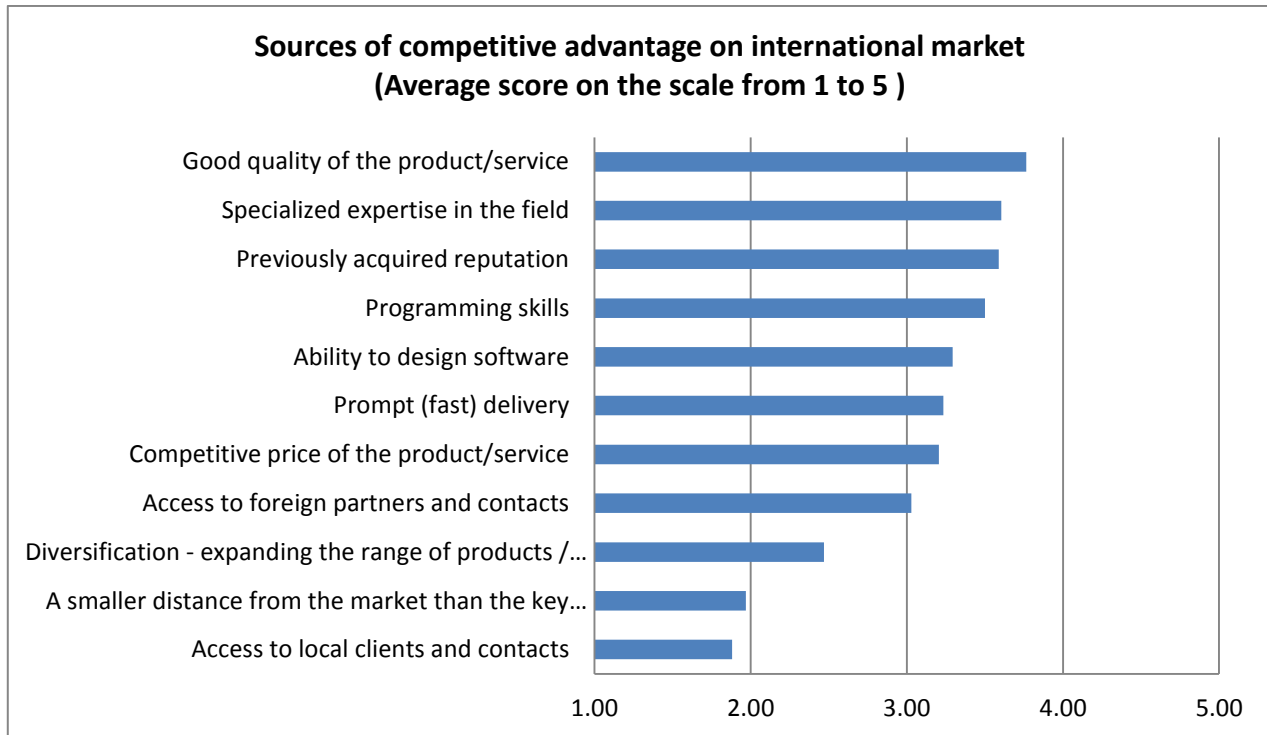
Figure 3: Importance of sources of competitive disadvantages on the domestic market



3.2.3 Competitive position on the international market

There are a lot of factors that are important for positioning Serbian Software companies on international market. Good quality of the products and services is the most important factor for creating competitive advantage. However, there are other factors that are rated with very high importance such as: specialized expertise; previously acquired reputation and programming skills (Figure 4).

Figure 4: Importance of sources of competitive advantages on the international market



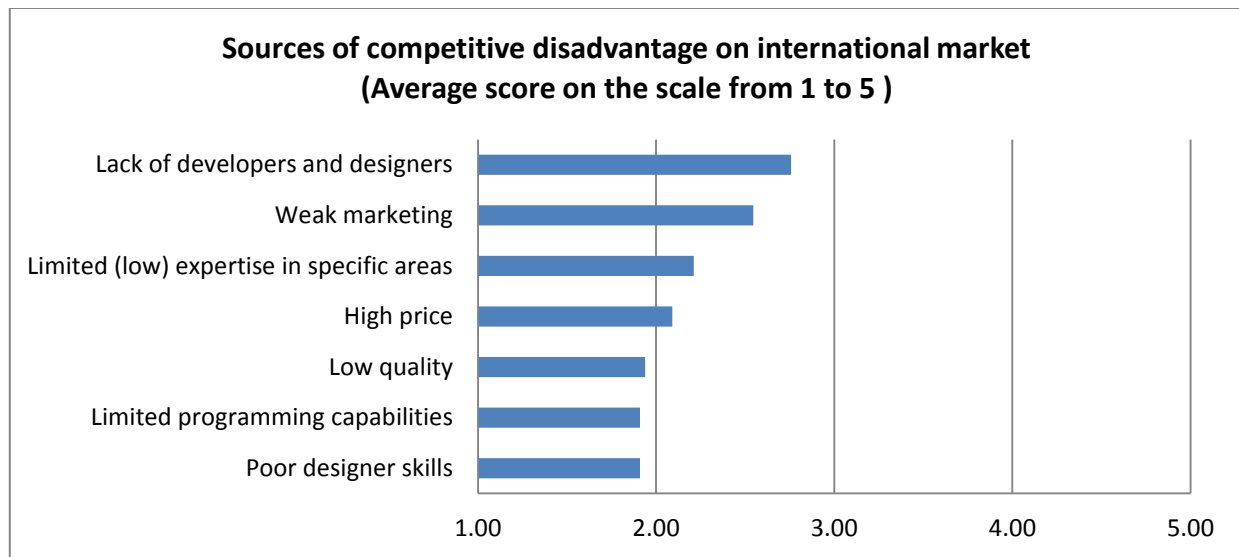
Although the average score of importance is not on the same level by the regions, results of One-Way Anova statistical test showed no significant difference in the sources of competitive advantage between the regions by most of the indicators (Table 6). The significant difference exists only between Belgrade and Šumadija and Western Serbia in the indicator Programming Skills. In contrast to Belgrade, programming skills are not competitive advantage on the international market for companies from Šumadija and Western Serbia.

Table 6: Average score of sources of competitive advantage per regions and statistical test of differences

	Belgrade	Vojvodina	Southern and Eastern Serbia	Šumadija and Western Serbia	One-way Anova Sig.
Ability to design software	3,81	3,11	3,25	2	0,233
Programming skills	4,19	3,44	3,25	1,5	0,016*
Competitive price of products / services	3,81	2,78	2,5	2,75	0,171
Good quality	4,25	3,67	3,25	3	0,435
Prompt (Fast) Delivery	3,75	2,67	3,25	2,75	0,270
Specialized expertise in the field	3,87	3,56	3,75	3	0,809
Diversification - expanding range of products / services	2,75	2,11	2,5	2,25	0,651
Access to foreign partners and contacts	3,38	2,22	3,5	2,5	0,254
Diversification - expanding the range of products / services	2,47	2,35	2,61	2,21	0,655
A smaller distance from the market than the key competition	1,97	1,98	2,04	1,82	0,540
Access to local clients and contacts	1,88	1,95	1,96	1,78	0,325

Importance of sources of competitive disadvantages on international market is very similar to those on the domestic market. Lack of qualified labour and weak marketing are the most important limiting factors on the international market (Figure 5).

Figure 5: Importance of sources of competitive disadvantages on the international market



3.2.4 Key disadvantages of the sector and what needs to be done to overcome them

In addition to the previous question regarding competitive disadvantages of Serbian software companies, table 7 summarizes the respondents' additional views on this issue.

Table 7: Sources of competitive disadvantages and what needs to be done

Sources of competitive disadvantages that are not listed in the previous section	What needs to be done to overcome the key disadvantages?
<ul style="list-style-type: none"> • Risk of fluctuation of IT experts, inability to focus on particular industries and build stronger expertise • Lack of skilled labour on the market • The lack of qualified personnel, who would be ready for further training and after the completion of their education, and, if necessary, to acquire new knowledge that they had not been familiar with. • Very high labour costs due to outsourcing • High contributions to salaries • The tax system is unfair, favours companies operating abroad • Weak marketing • The impossibility of publishing the game on Google / Apple App Stort from Serbia. • Taxation of a marketing budget that exceeds 10% of revenue 	<ul style="list-style-type: none"> • Increase the offer on the market by educating more IT specialists at faculties, colleges and secondary schools • Introduce programming in elementary schools • Change of the curriculum in higher education: software engineers, designers, architects of the solution should have deeper knowledge in certain areas of IT engineering. • Higher investments in professional development • More aggressive marketing and increasing visibility of the company and its attractiveness for highly skilled staff • Reducing the unfair relationship between taxes on regular employment and employment of people through intermediary agencies. • Creating a fair tax system that does not take 30% of the company's profit (in case of dividend payment). • Changing regulations to be competitive with other countries and in line with the needs of the companies themselves.

3.3 Strategic partnership and cooperation

3.3.1 Contractual relationship with foreign partners

The level of internationalization of Serbian companies in this sector is generally high. More than half of the companies from the sample have formal contractual relationship with their partners from abroad. Joint venture and Licence agreement are the most common forms of cooperation with foreign partners (Table 8).

Table 8: Contractual form of cooperation with foreign partners

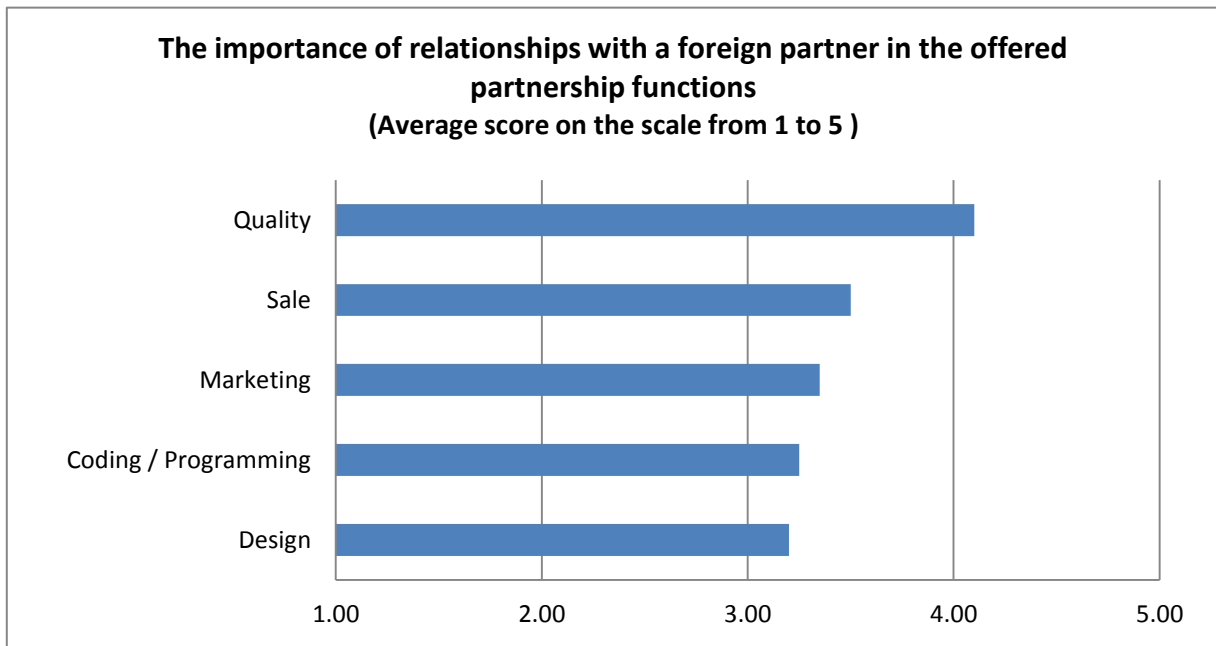
Form of cooperation	Total (%)
Joint venture	14,71%
License Agreement	14,71%
Manufacturer	11,76%
Authorized distributor	11,76%
Completely owned by a foreign partner	8,82%
A seller who provides significant technical support before selling	8,82%
Joint product development	8,82%
System partner	8,82%
Authorized reseller system	5,88%
Agreement on system integration	2,94%
Research and Development Agreement	0,00%
Agreement on joint production	0,00%

Source: Own calculations based on data from survey.

3.3.2 The importance of relationships with a foreign partner in the offered partnership functions

The quality of services offered is most important factor in the process of forming partnership with partners from abroad (Figure 6).

Figure 6: Average score of the importance of relationships with a foreign partner in the offered partnership functions



3.4 Placement and Market

3.4.1 Sales abroad

More than 57% of companies in software industry have sales abroad, among which, about 50% of companies have total income from sales abroad up to 50.000 EUR (Table 9).

Table 9: Distribution of companies by income from sales abroad (%)

Total income from sales abroad	Total (%)
0-50,000 EUR	52,38%
50,000 – 150,000 EUR	19,05%
150,000- 500,000 EUR	19,05%
500,000 – 1 million EUR	9,52%
1 million -3 million EUR	0,00%
More than 3 million EUR	0,00%

Source: Own calculations based on data from survey.

3.4.2 Factors of competitive position (advantages vs. disadvantages) of the main products / services

The competitive advantage of main products/services of software companies are based on good quality and satisfied need of new users. This is the most important factors of competitive position (Table 10).

Table 10: Factors of competitive position of the main products / services

Order of importance	Factors of competitive position of the main products / services
1	Good quality
2	Satisfied needs of new users
3	New solutions for existing user needs
4	Timely delivery
5	Services to customers
6	Low price
7	Terms of sale

Source: Own calculations based on data from survey.

Obsolescence of the main products and services, poor marketing and small offer are the most important diminishing factors of competitive position (Table 11).

Table 11: Factors that diminish the competitive position of the most important products / services

Rank	Factors that diminish the competitive position of the most important products / services
1	Product / service obsolescence
2	Poor marketing
3	Small offer
4	High price
5	Bad quality
6	Trade restrictions
7	Possibility of substitution

Source: Own calculations based on data from survey.

3.4.3 Measures/policies that would affect the company in the next few years, if the government introduced them now

The performance of companies is partially conditioned by the policies of the Government. With regards to concrete measures that should be introduced by governments, most of the companies consider that direct support to R&D and innovation in firms and Policy on entrepreneurship would affect the companies in the next few years (Table 12).

Table 12: Percent of companies that would be affected by governmental measures/policies

Governmental measures/policies	Total %
Direct Support to R&D and Innovation in Firms	54,55%
Entrepreneurship Policy	51,52%
Fiscal Incentives for R&D	36,36%

Governmental measures/policies	Total %
Policies for Training and Skills on Improving Innovation Capabilities in Firms	36,36%
Regulation	33,33%
Standardisation and Standards	30,30%
Innovation and Human Resources Migration and Employment Protection	24,24%
Policies to Support Collaboration for R&D and Innovation	21,21%
Public Procurement Policies	21,21%
Measures to Stimulate Private Demand for Innovation	18,18%
Support Measures for Exploiting Intellectual Property	15,15%
Technical services and advice	15,15%
Innovation Network Policies	15,15%
Technology Foresight	15,15%
Cluster Policy on Innovation	12,12%
Innovation Inducement Prizes	12,12%
Access to Finance, Publicly Supported Venture Capital and Loan Guarantees	9,09%
Pre-Commercial Procurement	3,03%

Source: Own calculations based on data from survey.

3.4.4 Instruments / measures / policies that companies suggest for better business

The following measures are suggested by software companies:

- Reducing fiscal and para-fiscal charges; reducing taxes and contributing to earnings; greater support for IT companies in terms of reducing the tax on profit, contributions to the salaries of new employees should be reduced.
- The elimination of politically preferable companies which get tenders for projects in areas where they do not have any experience. Deep analysis of the realized tenders for the public sector should be done.
- Providing conditions for the education of more people in IT education profiles
- Support local entrepreneurs through incentives in employment, taxation
- Reduce corruption at the highest levels - this would reduce the influence of privileged competition and better conditions for smaller firms would be achieved.
- Long-term incentives, Professional practice
- Start-up support: In the first 3-5 years, the company should be exempted from any tax on profits of up to 50 000 euros.
- Incentives for innovation, creating incentives for cooperation between local companies and joint ventures.

3.5 Innovation and Research and Development in the company

More than 70% of companies have introduced innovations in the last 7 years. The cooperation with the R&D sector in the country is on very low level since that only one third of companies have

collaboration with this sector. Although they don't have collaboration with R&D sector, more than 60% of companies realize their own research and development (Table 13).

The level of networking through clusters is also on low level, only 36% of companies are the members of any cluster in the country.

Table 13: Innovation management and Research and Development in the companies

Innovation and Research and Development in the company		Total %
Has the company had any innovation in the period since 2010?	Yes	72,73%
	No	27,27%
Does the company cooperate with scientific research organizations - faculties, institutes and research and development centers?	Yes	30,30%
	No	69,70%
Does the company realize its own research and development?	Yes	63,64%
	No	36,36%
Is the company a member of a cluster?	Yes	63,64%
	No	36,36%

Source: Own calculations based on data from survey.

3.6 Strategic Development Directions

3.6.1 Future plans of the management of the company

The software industry in Serbia recorded a large expansion in the last few years. Based on plans in the upcoming period, it can be concluded that the software industry will continue to expand. Penetration into new markets and development of new products/services on the domestic and foreign market are the next steps indicated by the large number of companies (Table 14).

Table 14: Future plans of the companies

Future plans of the companies	%
Penetration into new markets	56,25%
Development and introduction of new products / services on the domestic market	56,25%
Development and introduction of new products / services for the foreign market	46,88%
Development of the sales channel	43,75%
Expansion of exports on existing foreign markets	40,63%
Improvement of product quality and the introduction of a quality management system	37,50%
Providing more favourable conditions for the sale of products / services	25,00%
Provision of supporting services (servicing, etc.)	21,88%
Introduction of new production technology, automatization and development of	15,63%

Future plans of the companies	%
information support	

Source: Own calculations based on data from survey.

3.6.2 Key constraints for better realization of development opportunities

In order to achieve expansion and future development, regulations should be changed. Most important constraints for the future development opportunities indicated by the respondents are: high expenditure on taxes and contributions and unfavourable general conditions on the domestic market (Table 15).

Table 15: The rank of the key constraints for better realization of development opportunities (1 – most important; 10 – the least important)

Rank	key constraints
1	High expenditure on taxes and contributions
2	Unfavourable general conditions on the domestic market
3	Lack of own funds for investment and development
4	Insufficient and expensive loan offer from the domestic financial sector
5	Insufficient supply and difficult access to the use of foreign loans
6	Inadequate professional skills and non-motivation of employees
7	Inadequate production organization
8	A non-stimulating system of company functioning
9	Inadequate treatment on the world market
10	Inadequate foreign trade and foreign exchange policy

Source: Own calculations based on data from survey.

Although the ranks of key constraints for development opportunities are not the same in the all regions, there is no significant difference according to the results of One-way Anova (Table 16).

Table 16: Difference between regions in ranking of the key constraints for better realization of development opportunities

Key constraints	Test of difference	Sig.
Unfavourable general conditions on the domestic market	Between regions	0,757
High expenditure on taxes and contributions	Between regions	0,906
Lack of own funds for investment and development	Between regions	0,960
Insufficient and expensive loan offer from the domestic financial sector	Between regions	0,084
Inadequate foreign trade and foreign exchange policy	Between regions	0,631
Insufficient supply and difficult access to the use of foreign loans	Between regions	0,495
Inadequate treatment on the world market	Between regions	0,551
Inadequate production organization	Between regions	0,079
A non-stimulating system of company functioning	Between regions	0,802
Inadequate professional skills and non-motivation of employees	Between regions	0,661

3.7 Distinguishing characteristics of the companies

3.7.1 The future key trends

In this paragraph, concrete actions of companies, regarding the future activities significant for the company's businesses, are summarized. Future actions of respondents to questionnaires are the following:

1. Use of own technological know-how to penetrate the market of products and services across Europe, primarily in the field of services. The goal is to introduce technologies that are unavoidable in the process of digitization, primarily in the domain of communication.
2. Going to the regional and world market because it is difficult to achieve the planned goals on the domestic market due to low demand and investments in the public sector and economy.
3. Further growth is significantly limiting due to growing scarcity of ICT professionals and the increasing competition in the labour market
4. Greater investment in the professional development of employees; greater orientation to hiring beginners and re-qualified personnel as urgent solution.
5. Diversification of products and services
6. Opening to the foreign market
7. The challenge is to provide the necessary growth of the number of developers and this can slow down the company's actions. Testing new products on the domestic market and, in case of success, going abroad.
8. Expanding the number of employees due to increased demand for services
9. Introduction of new services
10. Completion of all software modules, increase of sales on the domestic market, development of solutions for the regional market, business standardization - procedures
11. Extension of the engineering team and continuous learning and promotion; inclusion in modern business flows, as a bridge organizer, and as a competent advisor.
12. Developing a network of contacts on the foreign market.
13. Web, SaaS, internet marketing
14. Recruitment and training of new staff and expansion into new markets; increase in the number of products offered, increasing the quality of services and existing products.
15. Increase the number of employees, in order to be able to respond to the increased demand of both existing clients and the acquisition of new clients.
16. Cyber security is becoming the primary concern in the world due to: 1) the growth of number of devices on the Internet (IoT) 2) the growth of cyber-crime 2) geopolitical trends.

3.7.2 Quality of human resources

In this paragraph, respondents' opinions on quality of human resources are summarized in order to gain a comprehensive view on their quality from the perspective of several companies. From their perspective, the quality of human resources can be reduced to the following points:

1. There is a decline in the quality of education institutions that produces insufficiently trained human resources. Only several faculties are providing quality IT human resources. There are a lot of small and large private faculties, almost none of which give adequate knowledge but only sell diplomas that do not serve anything.
2. The general impression is that the quality of new graduates is lower. Motivation for self-promotion is low.

3. There is a general trend that a certain number of employees who came to the firm as beginners, after several years of acquiring knowledge and experience, go to competing firms (mostly foreign) or go to work from home directly with foreign companies.
4. There is the shortage of labour force on the market trained for advanced IT services.
5. It is difficult to find an adequate and quality staff with experience. Foreign companies are able to offer better employment conditions. When hiring only graduates, it takes a minimum of 2 to 5 years of additional education within the company.
6. Start-ups are lacking money for quality staff, freelancing has raised the prices of IT staff
7. Insufficient individual interest of employees in training and lifelong learning.
8. There is a trend of re-qualification, but the most skilled employees are those with Higher education.
9. The general opinion about the quality of human resources in the ICT sector: a) the initial level of knowledge and skills is very good b) level of acceptance of new knowledge by employees is not enough
10. In general, the main disadvantage is lack of the broad spectrum of knowledge and experience in contemporary basic practices - project management, quality management and communication with clients.
11. Very high quality human resources in the companies, but insufficiently such people in the domestic industry in the offer.

3.7.3 Plan for further development of the company

The plan for further development of the companies with regard to technological development, domestic market, international market and human resources development are presented in this section. Only shortcuts for each segment are listed:

Technological development:

- Increase the mobile application development team
- More investment in education
- Invest more in mobile-based development
- Investing in equipment
- Development of new vertical solutions
- Continuous software upgrade, cloud options
- Improving knowledge and skills
- Procurement of new software tools
- Follow the latest trends and adapt to technological advancement
- Monitor technologies and developing own products
- Cooperation in the field of artificial intelligence

Domestic market:

- Further team development on different platforms
- Development of new solutions
- Testing and development of new services in the field of employment; development of new services in the field of e-commerce
- Active sales of products and services
- breakdown in the domestic ERP market in the lower segment
- Improve sales, increase the number of customers
- By hiring new employees to try to respond to increasing market demands

- Try to place something from products on the domestic market
- Joint venture

International market:

- Offer and develop a team to implement a hospital management solution
- Establishing partnerships with software companies in order to sell products
- A potential breakthrough with some new business model
- Active sales of products and services
- commencement of sales in the countries of the region
- A breakthrough on the new side of the market
- Improve sales
- Increase sales of products and outsource
- Finding new strategic partners

Human resource development:

- Further development of Data Science and Big Data team
- Invest more in professional development
- Investing in human resources and their training
- Employment of new people
- Strengthening links with faculties, scholarship programs for some educational courses.
- Recruitment of new staff and training
- Increase in the number of employees, further training of employees.
- Enable the best way to get to know employees with the development of new technologies
- Learn more people to do programming and give them a chance

3.7.4 State's priority for the development of the software industry in Serbia

In this section, respondents answers to the question: "What should be the state's priority for the development of the software industry in Serbia?" are summarized. According to their view, the following state measures should be implemented:

1. Providing quality IT staff in secondary schools and faculties: expanding enrolment quotas; innovating teaching content; change of curriculum.
2. IT modernization of the public sector which should generate new projects and inform the society about digital business, access to information. Compulsory establishment of electronic registers as basic public sector infrastructure and exchange of information between registries (institutions).
3. Reducing taxes and contributions for recruiting new workers
4. Enabling more efficient administration
5. Improvement of e-commerce
6. Making more up-to-date tax solutions for entrepreneurs
7. Create an environment for opening up to foreign markets, business and legal security. Promotion of high-tech services for which companies in Serbia have capacity.
8. Facilitating the existing IT courses at faculties to adapt more quickly to contemporary trends and industry needs. Enable the application of a law that allows employees and experts from companies to teach at faculties.
9. Stimulation for employment and stimulation of small and medium enterprises for investments in new information technologies. Support for open-source environments, education support, and employment incentives

10. It is necessary to create incentives for companies that have their own products, to empower them to penetrate quality on the world markets.
11. For Serbia, it would be very helpful for the domestic software industry to be more focused on the development of the domestic industry, or to support it. In one word, switching from outsource to domestic design and development.
12. State support in terms of procurement of new equipment (grants under the condition of employment), reduction of certain taxes and levies if IT has already been declared as priority.
13. Development of infrastructure; legal regulation and simplification of e-business. Legal solutions related to the ICT sector to be made in agreement and taking into account the suggestions provided by experts from the ICT sector.
14. Consider the imitation of the Israel Model for enterprise development, which is now being copied by Singapore and some African countries. It is based on the following three principles:
 - public investments in domestic innovation companies, especially those that sell on foreign markets
 - risk sharing with non-state investment funds
 - state projects to use the solutions of these innovative companies
 - insisting on the dominant participation of local human resources and staying in the country for the next 10 years, otherwise it is necessary to repay the invested money with interest
15. Harmonization of regulations that enable the establishment of start-up companies, sharing stock options and attracting foreign capital.
16. Eliminate laws and taxes that prevent doing business from Serbia. For example, paying taxes on over 10% of the revenues invested in marketing.
17. Establishment of a fund for financing domestic start-ups devoted to software development and introduction of tax reliefs for the same during the founding.

4. Main Findings II – Interviews with main stakeholders

Findings of the interviews with main stakeholders are derived by each stakeholder and then grouped according to major issues relevant for functioning and competitiveness of the ICT – Software programming sector in Serbia. Main stakeholders for ICT – Software programming sector in Serbia are:

- a. Managers of the major companies
- b. Leading researchers
- c. Government officials
- d. Business organizations
- e. Supporting organisations
- f. Other stakeholders

4.1 Main strengths of the ICT sector in Serbia

Exceptional and prolonged growth of Serbia's ICT sector makes this sector the absolute leader in Serbia's economy. Rapid development and promotion of IT services, especially in the field of internet and mobile technologies, application development, and outsourcing, is evident. Political stability and economic growth of Serbia as a country in the final phases of accession to EU and recognition and substantial support of Government of Serbia for the IT sector at the highest level (both political and financial support) has enabled this sector to develop in the desired direction. According to the interviewees, software industry in Serbia is characterized by the following strengths:

- **Well educated researchers and software professionals.** Companies operating in this sector have full access to well-trained individuals, particularly in Belgrade, Novi Sad and Nis.
- **Highly qualified, motivated and innovative workforce.** Main strengths are relatively well-developed human resources in younger generations, as well as language knowledge.
- **Good engineering skills** and mindset.
- **Proximity** and time zone in line with almost all EU member states as well as **cultural similarity** with Western countries.
- **Good command of English language** within the sector. This is especially evident in younger generations.
- Considerable number of **research institutes with long tradition in R&D.** The main strength is that Serbia has respectable research and academy workers and produce respectable experts in this area. The science and innovation in Serbia is obviously at a lower level than in Western Europe, but it is highly improving in the last decade. The main strengths are the existing research community and tradition, as well as good educational institutions.
- Overall innovative potential, technological knowledge and good education, concentrated in and around major university centres.
- relatively low price of doing business in Serbia as compared to EU member states,

- Small size of IT software companies allows **easier transition into agile/collaborative mode of support to their end users.**
- **Potential for growth** - Serbian ICT sector is still far from the saturation point. Fewer intermediates in business cooperation, which is the characteristic of this sector, enable companies to grow faster. Market potential for expansion (realistic potential of higher education sector and leading research institutions to substantially increase production of engineers in sought after areas of expertise, particularly at University of Belgrade, in a relatively short time frame).
- Capability of **producing the top-quality and highly innovative software solutions**, as well as all necessary services, know-how, and applied research capabilities that follow such solutions, with a lower labor costs compared to well-developed economies.

4.1.1 What needs to be done to further develop these strengths?

ICT is the first truly global business sector: it is not geometrical but rather topological in its nature, i.e. distance is not important but rather connectedness. This is why countries such as Serbia and regions such as the Balkans have the capacity to substantially advance in ICT. In most other fields distance is still important and being at the periphery is a big disadvantage – in ICT, as in modern research, distance is immaterial as long as one maintains connectivity. Connectivity implies data connectivity but also social connectivity. Social connectivity is what makes a country or a city interesting for foreigners to visit and relocate to. Language skills and willingness to engage and communicate, overall friendliness and openness, quality of life, a sense of security... all of these substantially effect social connectivity, all of these represent marked advantages for Serbia and its ICT sector to attract top people. Properly maintaining such a process will bring top experts to Serbia – first from the surrounding countries and their Diasporas, later from EU countries, and finally from strategic partners such as China, India, South Korea, US and Russia. Serbia in fact has realistic potential of attracting experts from emerging global and regional players such as Turkey, Israel, and Iran.

The process of remarkable growth of Serbia's software industry has already started. In order to enable further growth of the sector, Government needs to feed it adequately and consistently in the future period by conducting the following measures:

- significantly enlarge quotas for software engineering at public universities; increase the number of students who will become IT professionals through support of formal and non-formal education,
- introduce more advanced university programs for cutting edge technologies (e.g. big data, AI),
- finding solution for high school education and rising lack of teachers,
- further investments in education system
- stronger support to start-up and SME community, especially among young people; spreading of start-up and small business culture is very important followed by building additional infrastructure for business incubators,
- organization of practical internships for students on a higher scale; developing sponsorship and recruitment programs,

- improving the Law on higher education which allows people from industry to influence changes in the curriculum,
- institutionalizing and strengthening existing support for ICT by top level decision makers and building similar types of support at municipality levels,
- building on successes and continuing the overall process of increasing the ease of doing business in Serbia,
- strengthening financial instruments available to start-ups, particularly to new businesses with high added value for a society,
- substantially strengthening the innovation process (venture capital, angel investors, use of EU structural funds, joint projects of foreign and domestic ICT companies with leading research institutions in Serbia, setting up of strategic public-private partnerships),
- improving the regulatory framework, removing the road blocks from the legislative point of view (deregulate the domain and liberalize various e-payment methods e.g. PayPal)
- improve access to venture capital and favourable debt/equity-based financing, as well as a safety net to help drive risk-taking innovative entrepreneurial efforts

4.2 Most important challenges to the ICT sector

One of the biggest challenges that Serbia faces is brain drain. In order to alleviate it, significant development of the market and of the industry in Serbia is needed in order to make the mobility a two-way street. ICT is the most mobile and adaptable business sector. It immediately adapts to relative advantages in the market, labor force, business environment, as well as the capacities of the relevant research, development and innovation institutions. This mobility was the principle reason why the ICT sector has made such a strong foothold in Serbia in a relatively short time. That same mobility can become a principle challenge if the sector is not analysed and helped from the country level up to regional, European and global levels (e.g. Western Balkans, Balkans, Danube Region, South East Europe, European Union, strategic partners and markets at global level) and in the opposite direction down to intra-country regions, cities and municipalities.

Software sector is growing faster than the capacities of the educational institutions can respond to the demand for qualifications. According to the interviewees, the most important challenges of the software industry in Serbia are:

- lack of skilled labour on the market
- risk of fluctuation of IT experts
- rising of labour costs due to outsourcing
- unfair tax system (taxation of a marketing budget that exceeds 10% of revenue; high contributions to salaries; Ireland, for example, was very successful in luring multinational corporations with tax breaks, Ireland takes 2% from profit and in Serbia it is 15%, that is why some domestic companies are registered there; taxation of members of the joint stock company in Serbia is 15% and in Bosnia 0% etc.)
- financial regulatory framework (legislation and online payment - for online payments only dinars can be obtained; impossibility to publish new product on Google / Apple App Store from Serbia etc.)

- brain drain (young people very often leave not due to inadequate salaries, but due to low quality of life and overall corruption)
- the major scientific equipment (e.g., supercomputers, data centers, grids), knowledge-based resources (e.g. archives, databases), computing, software and communication infrastructure are insufficient or lacking
- weak marketing sector within the companies,
- weak connection between academia and industry
- low understanding of customer experience and customer journeys in product development

Some of the concrete problems of interviewed companies are summarized and listed below:

- **Status law as a problem:**
 - Joint stock company is limited to EUR 25000 founding capital - co-ownership is the solution in IT for paying employees and this is complicated in Serbia
 - LLC – an administratively burdened procedure with a notarisation - people from abroad must either come in Serbia or send the authorisation certified by the apostle; it is even worse in the case of transfer of a share or sale: the non-transferable transfer of a share only passes, everything else is burdened with unclear and large taxes; the founding capital is 100 din, but the founding fee is 10000 dinars, the tax on the assumed salary is paid in advance; bookkeeper has to be paid (min 50eur per month)
 - Too many freelancers: (50 to 150000?) - Unregistered entrepreneurs. Entrepreneurs do not know how much registration will cost them at that moment and the next 15 months? Designers and code writers do not know how much to pay to the state, and these are people who do not get into business until they know all the costs
 - The state needs 18 months for the adoption of a decision that is valid from the moment of registration, that's why people do not register
 - Good practices from other countries have not been considered. In Ireland there is an on-line calculator, in Germany - there is no calculation, as a registered entrepreneur pays 200EUR to 18000 EUR of annual income, therefore there are no unregistered.
 - The access to health care is restricted to the entrepreneur until getting solution and he pays it on the basis of some assumption
 - Taxation of entrepreneurs is unstimulated for employment because it is additionally burdened with taxes. Profit tax is 15%.
- **Banking rules as a problem:**
 - Inability to receive a micro transaction (\$1 is impossible to charge, which is done in IT). The bank would take 150 dinars for that dollar, resulting in 50 dinars minus. This is not up to the NBS but to the commercial banks.
 - Obligation to fill in the codes and the basis for receiving money from abroad - Banks also require proof of payment for any foreign payment - NBS has written that this is not mandatory, but commercial banks require a written confirmation in advance of payment in order to classify payments for statistical needs - inflows from abroad. Banks do not do this up to 1000 eur, so people pay several times smaller amounts. Financing terrorism and money laundering is an explanation for these bank procedures.

- Payment - Technical inability to pay in foreign currency - only dinar can be obtained from banks, because it is a domestic company, so for online payments only dinars can be obtained. Pay Pall is accounted for as a foreign currency transaction, all done in dinars, so they cannot make those payments that way. That is why domestic companies want to have accounts abroad.

4.3 Business model of the companies and subsectors/parts of the value chain present in the country

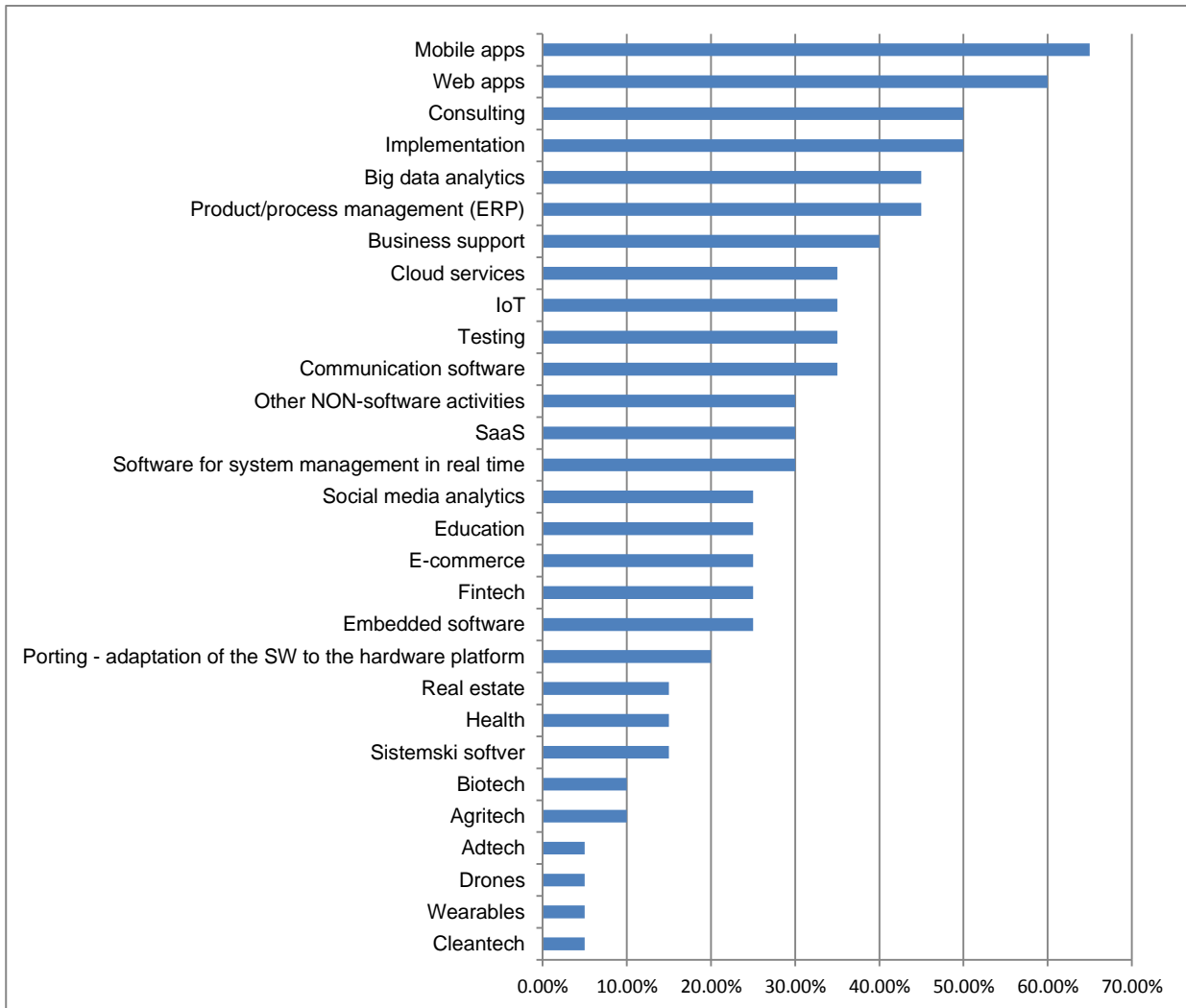
The software industry in Serbia is characterized by a high number of SMEs and freelancers, while the number of big companies is negligible. Nevertheless, the number of large companies in Serbia has been increasing since the beginning of 21st century. Some of these companies have more than one thousand employees and several hundreds of software specialists. Domestic companies strives to compete both on domestic and international markets with specific expertise, knowledge and skills with growing successes in niches such as gaming, entertainment and media, efficient management of large infrastructure networks (big data, distributed data systems), supercomputing (modelling of complex systems, visualization), smart printing, development of next-generation encryption technologies, sector-wide integration built around data acquisition and management (particularly in agriculture, health and environmental applications) and robotics.

The ways in which today's revenues come in the software industry range in a wide set of product-based models, outsourcing, market software services, advertising. All business models and revenue streams in this area are difficult to isolate and classify, as it is difficult to select the companies that represent the best representative of a particular model. The most common business model used by software companies from Serbia is based on outsourcing in which the companies mostly care about the final result, not the means that stand behind it. There is usually a pre-defined goal that the provider must reach within a defined timeframe. The goal is typically a more or less well-defined set of requirements that the developed software must meet. Companies from Serbia are engaged in developing of global products/services of foreign companies. This model is mostly used by small companies which large source of revenues is based on low-profit support services. IPR mostly does not stay in Serbia, with rare exceptions. They do outsourcing of the project, but they cannot take more jobs without people, and in the development of their own solutions there is lack of creative people and eco-system that supports entrepreneurship (education, mentoring for IT, sources of financing: missing of seed and VC).

In the last decade, some of the companies are redesigning the business model from outsourcing to developing their own solutions/products on the market. There are now growing number of companies that have their own products lines as well as project based businesses.

The most common types of product/services offered by software companies in Serbia are presented in figure below. Figure shows percent of companies offering particular product / service.

Figure 7: Type of product / service offered by ICT-SwE companies in Serbia



In different parts of the software industry, there are all parts of the value chain especially in Belgrade, Nis and Novi Sad. Generally, the most common challenge of domestic companies is related to project management. There is a limited capacity in this area and usually foreign partners are project coordinators.

On the global market, software 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: USA, Germany and the Netherlands. A trend has been observed, among the outsourcing companies, of making their own products with a high export value in the foreign markets. So far, a few companies have been successful, but these few companies made a worldwide success.

There is a good programmer base in Serbia. But, in order to excel in product development it is necessary to educate and train people how to develop new features, how to test them, how to interview users, how to identify potential improvement points, and similarly, it is necessary to increase capacities in Internet marketing and project management. Good understanding of UX/UI design together with collaborative/agile technics is typical weak point of local companies.

The strongest feature is overall innovative potential, technological knowledge and good education, concentrated in and around major university centres. However, there is a lack of know-how in addressing (global) market, specifically in business development and creating strategies for entering targeted markets.

The growth of the software sector in the countries in the region, especially in Romania, puts additional pressure on domestic companies to change the business model. The alternative for the software sector in Serbia seems to be to move to activities with higher added-value and start competing on the basis of innovation.

4.4 The most innovative companies in the sector

There is a significant potential at some university schools and research institutes. Certain domestic successful companies can also be role models for others. Finally, there are also some very successful efforts to apply the in agriculture, power production and distribution, renewable energy sources, etc. Some of the most innovative companies in this sector are:

- LimundoGrad
- Infostud
- StartIT and ICT Hub
- Quadra Graphics
- Microsoft Development Centre
- Bitgear
- NovellC
- 3lateral
- Mikroelektronika
- BioSense Institute
- Seven Bridges,
- BioIRC
- INFORA
- Levi 9
- VEGA IT sourcing
- GTECH
- PSTECH
- A51 d.o.o.
- Schneider Electric DMS NS
- RT-RK
- EPIX
- Nordeus
- HTEC
- Troxo-Atomia
- Frame
- COMTRADE S.E.
- EXECOM
- Advanced Security Technologies

- Institute Mihajlo Pupin
- HDL design house

4.5 Dynamics of the sector and the role of start-up companies in its development

This is a highly dynamic sector. Start-up innovative companies are of crucial importance for the further development of the ICT sector in Serbia. Start-up community is very strong in Belgrade and Novi Sad, in other regions is on the beginning, but in 2 years will play extremely important role in all regions of Serbia. As more information is accumulated regarding the sector it becomes more apparent that there are an exceptionally large number of small ICT companies that are still unaccounted for. Almost all information about the sector is coming from the larger companies, but the small start-ups play a crucial role - both together form a stronger ecosystem. The role of start-up companies is to bring innovation, to move fast and break the rules. They can be used as 'educators' in order to boost i.e. UX/UI and agile knowledge, since they are usually founded by industry experts that deliver this expertise in smaller teams.

Generally, the eco-system of support for entrepreneurship is very important. Freelance market is huge and their potential should be exploited. Government should create more intensive programmes to motivate freelancers to open up businesses.

4.6 Future trends significant for the development of the sector

Omnipresence of ICT, trend of raising awareness about the need for IT education and raising the competitiveness of the Serbian economy based on digitalization, indicates that demand will grow in the next period. Due to raising salaries and costs in Serbia for IT professionals, local companies which are present just on domestic market will have hard time improving themselves in IT terms, since they will have to give almost European salaries to local IT professionals. Many foreign ICT companies already established their branches in Serbia attracted by highly qualified and well educated young personnel and there is a trend of raising interest for this area.

In the next 20 years, each branch will be based on technology. Manual occupations are disappearing, creativity and scientific work will get a higher price. The banking industry already defines itself as a software company. The economy is transforming incredibly quickly. The changes are inevitable and the question is whether we will keep up with the changes or not, and that is the main issue for the state.

Start-up culture is improving since the number of start-up companies increases. Further development of ICT in Serbia will strongly influence - and be strongly influenced by - the following processes:

- Efficient functioning (of enterprises, government, large infrastructures)
- Digitalization (cultural heritage)
- Logistics (public procurement, transport, pharmaceuticals, defence)
- Data Science
- Data Security
- Virtualization of goods
- IoT - Internet of things

- Robotics
- AI - Artificial Intelligence
- Machine Learning
- GPU and other hardware accelerators
- Distributed computing infrastructures
- New parallel programming languages
- 3D modelling
- Virtual Reality
- Embedded Systems
- Smart-Grid Systems

Niche markets will grow around existing expertise:

- gaming, entertainment and media,
- efficient management of large infrastructure networks (big data, distributed data systems),
- supercomputing (modelling of complex systems, visualization),
- smart printing,
- development of next-generation encryption technologies,
- sector-wide integration built around data acquisition and management (particularly in agriculture, health and environmental applications),
- robotics

4.7 Competition at the international level and the level of internationalisation

The level of internalization is very high. The vast majority of software companies in Serbia are either branch offices of foreign companies, or domestic companies that use outsourcing business models (develop solutions for foreign clients):

- Some of well-known companies have established their development centres in Serbia (e.g. Microsoft)
- Some of successful domestic enterprises are acquired by foreign companies (e.g. Schneider Electric DMS NS).
- There are examples of fast growing companies that are influential abroad in its area of competence (e.g. Nordeus, ProSense)
- There is also a number of companies and even individuals included in software and hardware outsourcing business.

There are plenty of regionally present businesses, but there's a lack of support for achieving international links, recognition and cooperation.

Level of competitiveness is generally high at the international level. Serbian ICT sector is capable of producing competitive ICT solutions, recognized all over the world. Companies in Serbia are more competitive in terms of engineering (ability to build) when compared to their commercial performance (ability to commercialize). Individuals and enterprises from Serbia are still not purchasing knowledge on the global market and investing it into Serbian economy. The opposite process is visible - the world is starting to identify and buy existing local knowledge and expertise.

It is now a great chance of Serbia to become a country situated among the leading ICT countries in the world and finally to move to the society of medium-to-high developed economies, despite that it is on a global market a very small economy.

The competition on domestic market exists only around people and finance (companies that are on tenders and trying to get the same jobs) but they do not meet on the global market. Competition for employees is very strong, one of the initiatives emerged is to achieve a "gentlemen's" agreement that there is no taking other company's employees.

There is no competition in terms of customers, the market is global and demand is high. Cooperation within sector is present in two forms:

- joint effort in applying for EU projects
- smaller companies are hired by bigger companies as subcontractors

In the foreign market, competition issues are exceeded with the quality of products, safe delivery and practical experience gained through the realization of projects and cooperation with large IT companies.

All companies in the sector are competitors but the market is too big and there is room for everyone. Clients from the US often compare companies from the Serbia with India and Pakistan, which are cheaper than Serbia. They may possibly have a problem with this because the services from these countries are cheaper, but the service is significantly worse, so they are more willing to pay more to Serbian companies. Romania and Serbia have a good reputation. They proved to be good in comparison to countries from the East.

4.8 Competitiveness on domestic and foreign market

Domestic market is relatively small and demand is low. The main problem in domestic market is the outflow of staff into other companies who are able to offer higher salaries. In addition to quality of product/service and knowledge, the most important factor on domestic tenders is price.

Competitiveness on foreign market is based on a cheaper service with good quality. What distinguishes Serbian companies from other competitors is a good price-quality ratio. However, lower price has lost its position as a key factor (couldn't compete with India). The most important factors for competitive position are knowledge and services as well as good relationship with the foreign partners and clients. Competitive factors on global market could be summarized into the following:

- Good quality and comprehensive technological solutions
- Quality of product/service and knowledge recognized at world level,
- High quality of personnel and engineers
- Proximity and time zone Uniqueness
- Established trust

Some software companies from Serbia are capable to offer unique technologies in the niche market, e.g. Schneider Electric DMS Novi Sad is currently the world's leader in the integration of large systems - the integration of operational technologies and information technology into a single platform. All major IT companies recognized their interests in cooperation with Schneider Electric

DMS Novi Sad, with whom they participate in the construction and integration of different platforms. Schneider Electric DMS Novi Sad is a global leader in Advanced Distribution Management Systems.

4.9 Research infrastructures in ICT sector

This status of research infrastructure is unsatisfactory. The major scientific equipment (e.g. supercomputers, data centers, grids), knowledge-based resources (e.g. archives, databases), computing, software and communication infrastructure are insufficient or lacking. There is no shared infrastructure, no funding for technical maintenance. It is left to individual groups to self-organize. Generally, there is no national planning, no funding at the national level.

Broadband internet is not sufficient. The ratio between download and upload is too high and IT companies complained. It is already included in the law that the ratio cannot be higher than of 4:1. At the moment internet providers offer 20:1. It has to be changed. Problems identified 10 years ago are very similar today. The interests of Telekom are greatly influenced here.

4.10 Tools and ways of coordination in the government and main funding schemes

There is in general communication problem and insufficient consensus within the government institutions and ministries. Horizontal communication needs to be improved. It exists in the way that opinions are usually gathered but does not work; it is not finally realized because of political changes and frequent elections. There are ideas but the problems are interest of certain groups, ignorance and resistance to change. There are no specialized tools used for this process. The government administration is unmotivated, there is no stimulation to work and the number of employees is falling. After retirement, there is no new job position available. There is a lack of professionals and people with a vision. Bureaucracy often inhibits the system.

Innovation policy is organized top-down, but takes into account the recommendations and findings of the implementing organizations down the chain. There are some permanent funding schemes from the government and also some occasional national funds for making the connections between academia and industry. However, it is by far insufficient as Serbia is recognized as one of European countries with the lowest percentage of GDP for funding of science and research activities. There is also some access to funds of EU through Horizon calls, ERASMUS, IPA, Danube Initiative etc. restricted by high competitiveness of the process and the fact that Serbia is not an EU member. International funding schemes are tough and require well-composed consortia. However, the assessment is mostly fair and, once approved, the funding goes according to the well-known schedule

National funding is quite unstable, calls are scarce and criteria are always in flux. Personal connections are very important, and the quality of the R&D does not necessarily translate into favourable decision and funding.

The main calls of financing innovation activities are supported by Ministry of Education, Science and Technological Development and Innovation Fund (IF). The IF contributes to developing Serbia's innovation policy goals by relaying its findings related to interaction with innovative Serbian SMEs. The IF has access to funds from the state budget of the Republic of Serbia via the

MESTD (Ministry of education, science and technological development), as well as EU IPA funds available to Serbia as a EU candidate. The IF coordinates all of its financing efforts through direct communication with the MESTD, MOE, MOF, Delegation of the EU to the Republic of Serbia, the World Bank and the Minister in charge of innovation and technological development. In total, 4 programs are available at the IF, with periodic organizing of call for proposals for 3 of them (Mini Grants, Matching Grants and the Collaborative Grant Scheme) and a continually open call for proposals for the Technology Transfer Program.

4.11 Actions most important to support the growth of innovativeness and competitiveness of the ICT sector

Serbian government has proclaimed the education and digitalization among its highest priorities. They have recognized the potential impact and benefit of the improvements in the ICT sector on the entire Serbian economy. Both innovativeness and ICT are cross cutting phenomena and support of variety of other sectors will enable development and growth of above mentioned, rather than focusing on ICT solely.

The state should open the public sector for innovation and to be an accelerator of development. This will lead to optimization of the process and provide human resources for other jobs.

Table 17 shows the measures that are considered as most important by interviewees. According to their opinion, access to finance, publicly supported venture capital, loan guarantees, fiscal incentives for R&D and direct support to R&D and innovation in firms are the most important measures mainly for start-ups and small companies in Serbia.

Table 17: Policy incentives/support for innovation – distribution of the policies according to replies collected from interviewed companies

Percent of companies supporting measures (%)	
Access to Finance, Publicly Supported Venture Capital and Loan Guarantees	65,0
Fiscal Incentives for R&D	55,0
Direct Support to R&D and Innovation in Firms	55,0
Entrepreneurship Policy	50,0
Policies to Support Collaboration for R&D and Innovation	40,0
Support Measures for Exploiting Intellectual Property	35,0
Innovation Inducement Prizes	35,0
Policies for Training and Skills on Improving Innovation Capabilities in Firms	30,0
Measures to Stimulate Private Demand for Innovation	30,0
Regulation	30,0
Innovation and Human Resources Migration and Employment Protection	25,0
Cluster Policy on Innovation	25,0
Innovation Network Policies	25,0
Public Procurement Policies	25,0
Technology Foresight	15,0
Pre-Commercial Procurement	10,0
Standardisation and Standards	10,0
Technical services and advice	5,0

Concrete measures proposed by respondents are summarized in two groups:

- Increasing investments, incentives
- Legal and financial framework
- Education

- **Increasing investments, incentives**
 - Investments in science and research, as well as in technology transfer. Connect innovation, start-up and big companies
 - Significantly increase IT investment per capita (it is only 60\$ and far below EU average)
 - Providing good infrastructure and access to finance (Government level – policy making especially on alternative funding sources, e.g. venture capital, business angels, accelerators...). Market oriented trainings for ICT companies and entrepreneurs in order to prepare them for go to market process. (Innovation ecosystem actors such as: incubators, hubs, accelerators)
 - Reaching out to other industry sectors in need of ICT services, e.g. agriculture and food processing, energy efficiency, engineering, various service providers... (Private partnership).
 - Encourage investment in the domestic IT sector (examples of Israel, Kotra)
 - Tax incentives for the whole ICT sector, especially for start-ups, contact with investment funds, business angels, etc.
 - Contribution, state incentives: example of setting up a start-up firm in Israel 40% of the state and 60% private capital
 - The state should provide a fair competition and support: to give faculties and institutes money for cooperation with industry - a voucher system, with rigorous criteria not to be abused. 3-4 accelerator project was done, there is interest among companies – AgriHitech. Enable funds for business development in ICT and overall tech innovation (translating the tech into commercial results).
 - The state should change approach in science financing, as a social approach to ensure social peace in the sector. In addition to focusing on securing social peace, the state should also ensure financing of excellence in science and to finance projects that have added value.
 - Intensive investments in fundamental and, over all, applied research. Intensive investments in a really modern and competitive education system
 - Developing a more significant financial and non-financial support to start-up companies.
 - Support to the development of own products because most of the sector is focused on outsourcing

- **Legal and financial framework**
 - Better organization of administration at all government and non-government levels.
 - Laws are not respected enough. There are not enough inspectorates for electronic communications; there are a total of three inspectors in Belgrade and one in Vojvodina. The IT Action Plan adopted in 2016 is solid but needs to be applied and much more emphasis should be on developing own products. In order to attract investors, Serbia

must have harmonized laws with the world, which means that at this moment it is impossible to introduce a foreign partner.

- Regulation that would allow crowd funding as it does in the world (the opportunity to be easily traded into a crowd financing company)
- The state should provide, in addition to funding innovation, simplifying its operations and enable to make more efficient use of its available time - a lot of time is spent on administrative obligations (VAT recording is terribly complicated, now 500-600 eur are paid for various things via internet, there are taxes on non-resident services, and proof that you do not have to pay the tax is too complicated)
- The state should provide a transparent and fair business framework! Junior is expensive on the tax level, which is why companies find different solution and that is not doing business.
- The state should enable something and not to hinder. It is necessary to eliminate barriers so that companies could operate:
 - i. PayPal does not work for payments between residents. It needs to be improved. Temporarily, payments are going through Romania or other countries
 - ii. Importing a testing device – a console – this is impossible because of the with customs misunderstanding of that technology.
 - iii. It is not possible to publish products on the Google and Apple platforms.
 - iv. In Serbia, marketing budgets that exceed 10% of revenues are taxed. It is very common in this industry to invest in marketing 30-40%.
- The state should ensure that the company can register in a foreign language as is the case in other countries.
- The state should also enable the registration of short names.
- The state should suppress the grey economy - fully legalize IT
- E-commerce is based on terms that are meaningless. It is complicated to charge online service and there is a risk of punishment. Consequently, innovation in this sector is hampered
- The state should conclude international treaties on the avoidance of double taxation.

- **Education**

- Promoting the spirit of innovation at the level of elementary and high school (science and industry fairs, competitions, etc.)
- Work on education in the ICT field, flexibility in introducing new topics in the ICT field education, especially at the university level
- Reform of university education with goal to increase quantity and speed of courses improvement in universities. Also, it is important to promote speakers and guest professors from industry
- Some solutions from high schools – not only that we are running out of IT professors in high schools (they are moving to industry for higher salaries), but there is a rising problem of decreasing number of students enrolling math faculty to study for teachers (usually those who could teach mathematics, could also work in IT, and they more and more often chose the latter due to significantly higher income)

- To include informal education into formal – accelerator programs (StartIT academy is a good example of that)
- Prequalification program. A complementary action that requalify some people from other sectors for some lower-level competencies in the ICT sector,
- The state should provide an impact on education to reduce the gap between needs and knowledge supply; the quality of programs at all levels of education must be raised; stable regulation that gives predictability in business; that the state does not make an uncompetitive game with the diversity of regulations (support for foreign IT companies that take our developers; the employment of temporary and permanent employees is different, so everyone runs in the grey zone)
- Significantly increase the throughput of schools in computer and software engineering:
- Start with coding from primary school and have junior programmers after secondary education,
- Improvement of higher education in systematic way: Providing enough well educated professionalists in Software Engineering, Data Science, Computer Science, Informatics, Computer Engineering and related disciplines, in general. The most important factors are to improve academy education in this area and create attractive working environment which is competitive enough to attract professionals from abroad to come to Serbia and work here. Even, to attract well-educated people from neighbouring countries to come here and continue with his or her professional life here, in Serbia, because it is more competitive in many aspects than the others. Stable general economy conditions for business are a must for this.

There are also good initiatives regarding education that has already taken place. In the framework of the Digital Serbia Initiative, females received materials in primary schools in the programming languages Python and Scratch. At the same time, training for IT professors was paid. The goal is that after the high school, young people work as junior developers. It is created a plan for 7th and 8th grade and everything is in accordance with the Ministry of Education, Science and Technological Development

4.12 Innovation activities: drivers and barriers

Innovation may be broadly defined as the successful commercial introduction of a new product, service or process. According to the OECD's Oslo Manual (OECD, 2005), innovation refers to the implementation of "technologically new products and processes and significant technological improvements in products and processes". Software innovation can be seen as a process leading to: development of a novel aspect, feature or application of an existing software product or process; introduction of a new software product, service or process or an improvement in the previous generation of the software product or process; and entry to an existing market or the creation of a new market.

Serbian software companies are mainly doing incremental innovations for existing technologies i.e. iterative improvement of an existing solution, not entirely new, but a new way to use existing technology.

The most of companies operating in this sector do not deal with the intellectual property rights. In the case of software contracts, generally, there is no comprehensive understanding of the intellectual assets generated in software development outsourcing and the related IPR involved and the contingency factors that determine when vendors are more likely to obtain IPR from clients. General explanation for this trend is that new software solutions are rapidly developing and applying, which makes difficult to protect them in the form of patents. At the same time, it prevents the competition from copying them completely. In addition, for the realization of the projects, it is not enough to have software; the basic problem is its practical application in real control centres, its integration with the existing components, its adjustment to the specific requirements of users and maintenance.

Software innovation is often driven by user need and expectations, and at times in the development process, software designers often solicit users feedback. According to the respondents' observations, **key drivers for innovation** in Serbian software sector could be summarised into the following:

- Market needs and market opportunities simultaneously taking into account “science push” and “market pull” factors. The need for innovation comes from analysis of the existing market and potential needs and necessity to adapt to market changes.
- Client's needs and requests - Rising customer expectations regarding service and quality. Recognizing the needs that users have and solving these needs on innovative ways are the important drivers for innovation. Clients have a problem or they are looking for small changes in existing solutions, Software companies usually identify technology that can be a solution for the client's problem.
- Internal capacities within the companies and innovative ideas come from workers. Idea for innovations happens within the company very often by fostering internal competitions for new innovative solutions.
- Increased competition. Keeping pace with key competitors on the market.
- Participation in EU projects, cooperation with international partners.
- Internal estimation of business trends and technological development, world trends, examples of good practice, legislation etc.
- Cooperation with business incubators for mentoring and other assistance and membership in the clusters

On the other side, **key barriers for innovation** in software sector are:

- The lack of investments, potential investors are still not active enough on the market.
- Small market and low demand on domestic market
- Modest R&D funding in Serbia. Scientific research system is completely separated from the economy.
- Slow and expensive patenting process
- Society is conservative, especially state administration - poor organization
- Adoption rate – the market slowly sets out the requirements for new solutions
- Lack of incentives for innovation from the government funds

- Lack of capacity and high-quality personnel. Education system does not provide a sufficient number of quality personnel in the sector
- The lack of staff
- Insufficient cooperation with universities
- Risk aversion

4.13 Cooperation with R&D sector

There is generally low level of academia-industry cooperation. Huge number of companies in this sector doesn't have any kind of cooperation with the R&D sector and have no idea how to use cooperation. For those who cooperate, collaboration is rarely based on formal cooperation agreement, but it is more reduced to personal contacts.

Knowledge transfer from Academy to industry is very low. It is not systemically supported. The most common types of cooperation with academy sector could be summarized into three forms:

1. Informal cooperation with academic institutions through practices, scholarships, student workshops, Internships etc.
2. Informal cooperation with professors and researchers
3. Joint application for research projects financed from domestic and international funds (e.g. Horizon 2020, Innovation Fund etc.)

Although, the collaboration between these actors is very weak, there are exceptions and some software companies have good cooperation with research institutes and technical faculties. Schneider Electric DMS NS has extremely good connection with the Faculty of Technical Sciences in Novi Sad. The company contributes to writing new curricula. A new direction is made, which is a combination of computers and energy. Based on the experience of the company, together with the Faculty, the structure of the new modern engineer is defined, which is needed not only in Serbia, but in the whole world. Within the company there is a special team that deals only with youth education. The company has realized the Fund for Young Talents, which currently has about 300 high school students. They spend regular hours in technical disciplines (mathematics and computer science) at the expense of the company. This year, they also started courses with online lessons. Under this fund, young people are being trained to pass mathematics exams in secondary schools and colleges. In this way young people get informed and orient themselves to technical professions. In the later years of study, young people can, through the scholarship program, also concentrate on the area in which the company is engaged, or to be employed at the same time at the end of the studies. The entire program is supported by the Ministry of Education, Science and Technological Development. On the realization of projects, the company hires a large number of people from the University of Novi Sad. At the same time, a large number of students are additionally educated in the company. In this way, students acquire additional narrow specialist knowledge necessary for working in the company. This is very important because today it is extremely difficult to find people who are narrowly specialized for the operational problems of modern electricity companies, while having knowledge in the field of information technology. Company has for the last 7 years continuously among 160-200 scholars. So far, the scholarship program has passed between 600 and 700 students.

This example is good practice but unfortunately it an exception. General reason for low collaboration with R&D sector is that there is no functional centre for technology transfer in the country. Although, Serbia has established Technology transfer offices in Belgrade, Novi sad and Nis, this way of transfer technology hasn't shown as too much successful.

4.14 Membership in the clusters

Only a third of all companies in Serbia are members of clusters. Some of most often reasons for this are:

- they do not see a significant benefit from the membership
- it is costly (e.g. membership of 100 euros for a start-up is too much)

One of the good examples of clusters in Serbia is Vojvodina ICT cluster which operates since 2010 with the idea of building the strong network of international contacts; enabling its members to create new business opportunities; lobbying to change the business conditions in the Serbia; the popularization of IT in the RS etc.

The list of ICT Clusters and Support Organizations in this sector active in Serbia is the following:

- Vojvodina ICT Cluster
- ICT Network Serbia Cluster
- Nis Cluster of Advanced Technologies - Ni CAT
- South-Eastern Europe ICT - SEE ICT
- Regional ICT Cluster – Kragujevac
- IT Cluster Subotica
- Zrenjanin ICT Cluster
- Digital Serbia Initiative
- ICT HUB
- STARTIT

Few big players with the support of Digital Serbia Initiative are currently considering the establishment of a Gaming Association that does not exist in the Serbia. In that way, software companies in gaming industry will defend their own interests in Serbia.

5. Main Findings III – Market analysis of software sector in Serbia

Analysing NACE Rev. 2 classification of economic activities and section J-Information and communication, the following groups were identified as part of software sector:

- 58.2 Software publishing
- 62.0 Computer programming, consultancy and related activities
- 63.1 Data processing, hosting and related activities; web portals
- 63.9 Other information service activities

Therefore, for the purpose of market analysis of software sector in Serbia, these groups of economic activities will be used.

Total turnover of software sector in Serbia in period 2010-2015 shows an upward trend (figure 7). In a 5-year period, total turnover has more than doubled, i.e. it increased from 34,6 billion RSD in 2010 to 75,5 billion RSD in 2015.

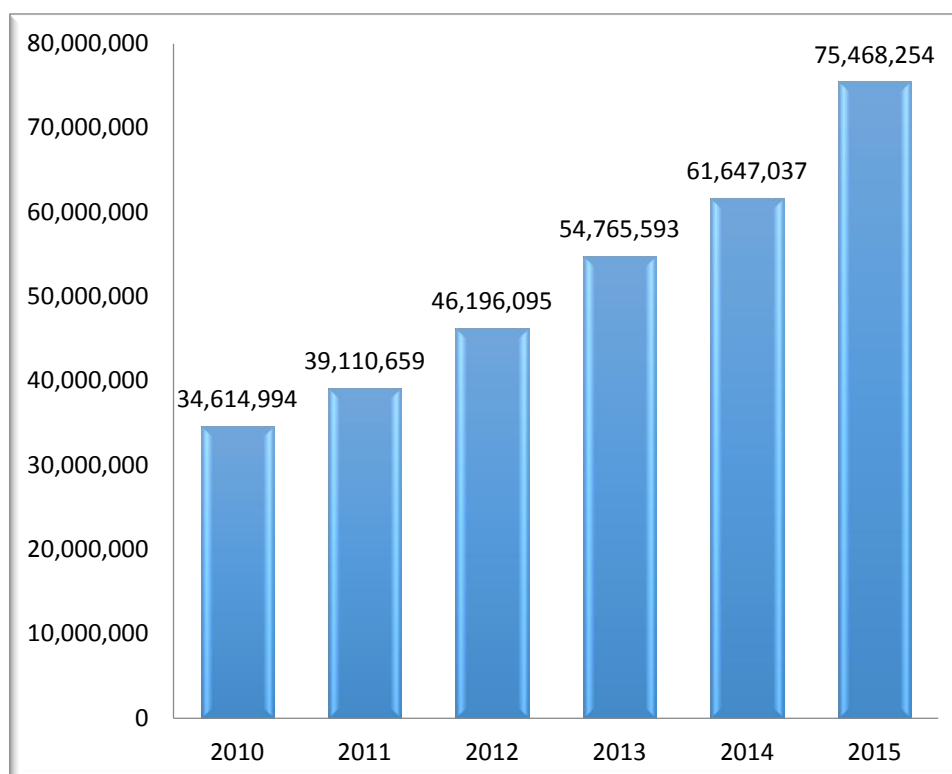
Software sector will be analysed on the basis of its turnover, employment and salaries, export and import and results of Community innovation survey in 2016. Relative position of Serbia will be presented in comparison to the following Danube Region countries: Bulgaria, Czech Republic, Croatia, Hungary, Austria, Romania, Slovenia, Slovakia and Bosnia and Herzegovina.

5.1 Turnover of software sector in Serbia

Total turnover of software sector in Serbia in period 2010-2015 shows an upward trend (figure 8). In a 6-year period, total turnover has more than doubled, i.e. it increased from 34,6 billion RSD in 2010 to 75,5 billion RSD in 2015.

Structure of turnover in software sector presented in table 18 indicates that the majority of activities in this sector was related to computer programming, consultancy and related activities (62.0). The share of this activity was around 90% throughout the whole observed period and it has grown for 3,69% in 2015 in comparison with 2010. Services in the field of data processing, hosting and related activities; web portals (63.1) are also important part of the software sector, although they show a downward trend in the respective period. The share of this group of activities declined for around 4,12% in 2015 in comparison with 2010. *Software publishing* (58.2) and *Other information service activities* (63.9) represent less significant (less than 1%) part of the turnover in Serbian software sector.

Figure 8: Total turnover of software sector in Serbia (in thousand RSD)



Source: Statistical Office of the Republic of Serbia

Table 18: Structure of turnover in software sector in Serbia (in %)

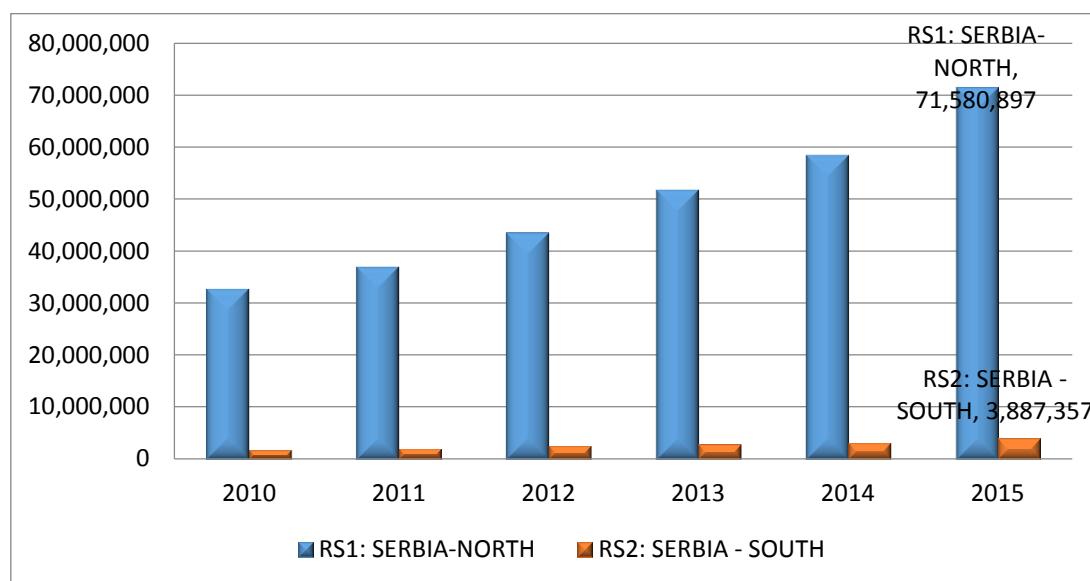
	2010	2011	2012	2013	2014	2015
58.2 Software publishing	0.03	0.21	0.32	0.46	0.34	0.61
62.0 Computer programming, consultancy and related activities	89.09	91.44	90.83	91.18	91.35	92.78
63.1 Data processing, hosting and related activities; web portals	10.18	7.71	7.60	7.27	7.61	6.06
63.9 Other information service activities	0.70	0.65	1.25	1.09	0.70	0.55

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

There are huge regional disparities in the distribution of software sector turnover between north and south of Serbia (figure 9). Turnover of software sector in the North of Serbia (regions: Vojvodina and Belgrade) is around 20 times higher than in the South of Serbia (regions: Šumadija and Western Serbia, Southern and Eastern Serbia) in the observed time period.

Regional distribution of the turnover in software sector is presented in more detail in table 19 where are observed four regions in Serbia. In Belgrade region the turnover recorded absolute growth in a 5-year period and average share of around 80%. However, it is visible a slight decrease of its share for around 3,2%. Turnover of software sector in Vojvodina had both absolute and relative increase: it recorded a growth of 7,4 million RSD and 3,1% in the end of the period. Turnover of this sector in the region of Šumadija and Western Serbia and in the region of Southern and Eastern Serbia slightly increased in absolute term, but in its relative share it was almost constant: 2% and 3% respectively.

Figure 9: Regional distribution of turnover of the software sector between North and South of Serbia



Source: Statistical Office of the Republic of Serbia

Table 19: Regional distribution of turnover of software sector between four regions in Serbia (in million RSD and %)

	2010		2011		2012		2013		2014		2015	
	mil RSD	%	mil RSD	%	mil RSD	%	mil RSD	%	mil RSD	%	mil RSD	%
RS11: Belgrade	28.556	82,5	32.232	82,4	37.736	81,7	44.891	82,0	10.114	81,3	59.828	79,3
RS12: Vojvodina	4.313	12,5	4.868	12,4	5.949	12,9	7.059	12,9	8.491	13,8	11.753	15,6
RS21: Šumadija and Western Serbia	659	1,9	815	2,1	906	2,0	1.006	1,8	1.112	1,8	1.597	2,1
RS22: Southern and Eastern Serbia	1.088	3,1	1.196	3,1	1.605	3,5	1.810	3,3	1.930	3,1	2.290	3,0

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

In comparison with selected Danube Region countries, Serbia had considerably lower turnover in software sector (table 20). Only Bosnia and Herzegovina recorded a lower level of turnover in period 2010-2015. Czech Republic, Hungary and Austria had substantially higher turnover in software sector which in certain years was more than 10 times higher than in Serbia.

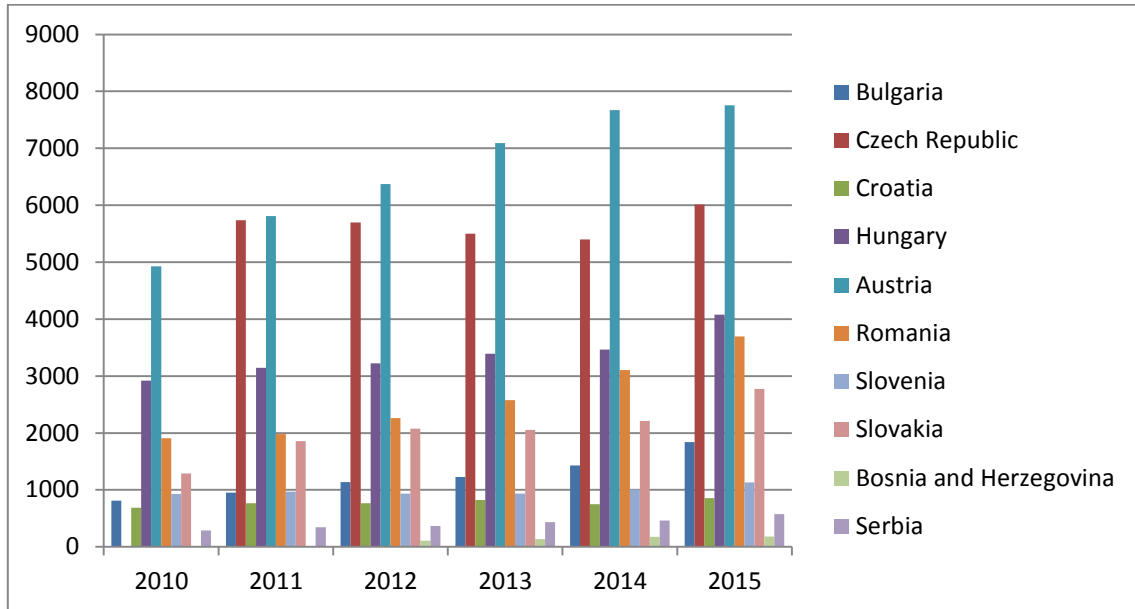
Table 20: Total turnover of software sector per countries (in mil EUR)

	2010	2011	2012	2013	2014	2015
Bulgaria	968,1	1122,1	1342,7	1450,1	1691,7	2158,4
Czech Republic		6912,8	6897,6	6797,1	6828,1	7693,8
Croatia		906,5	882,4	959,6	886,8	1010,8
Hungary	3758,8	4048,6	4112,9	4378,3	4484,1	5123,7
Austria	7624,6	8960,9	9601,9	10415,6	11208,3	11395,8
Romania	2477,2	2643,5	2880,4	3291,3	3990,6	4657,9
Serbia	325,7	380,0	406,9	477,4	507,3	619,9
Slovenia	1046,6	1058,7	1025,7	1138,2	1118,9	1259,6
Slovakia	1667,4	2393,4	2634,5	n/a	n/a	3465,1
Bosnia and Herzegovina	n/a	n/a	132,6	155,7	199,3	210,8

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

When observing group 62.0 Computer programming, consultancy and related activities, conclusions are similar as for total turnover of the software sector. Serbia has lower level of turnover than all selected countries, except Bosnia and Herzegovina (figure 10).

Figure 10: Turnover of group 62.0 Computer programming, consultancy and related activities (in mil EUR)

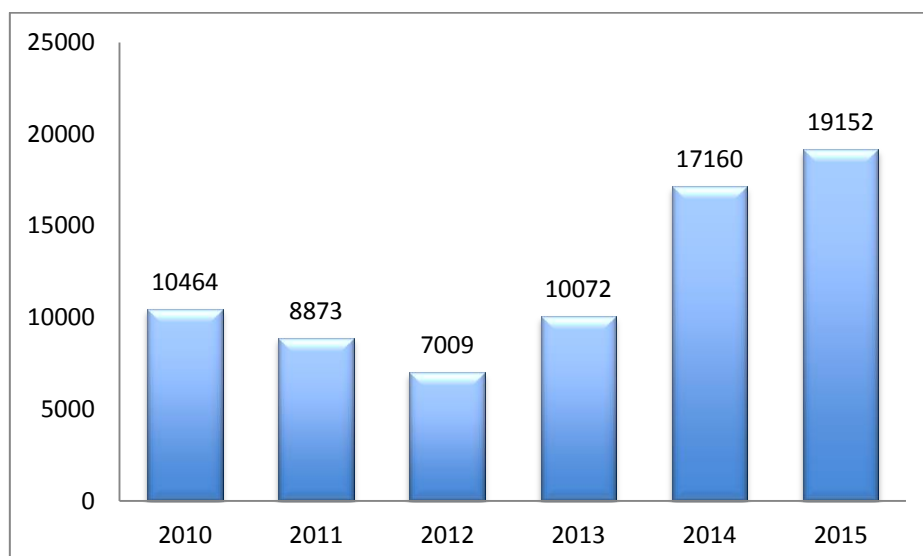


Source: Eurostat and Statistical Office of the Republic of Serbia

5.2 Human resources in software sector in Serbia

Serbian software sector was employing 19.152 workers in 2015, which is a modest number in comparison to 2,57 million of total number of employed persons in the country. According to the data from figure 9, number of employees in software sector declined in 2011 and 2012, but in 2013 it began to rise and from 2010-2015, number of employees almost doubled. These trends confirm developing character of the sector which is in line with data on turnover of the software sector.

Figure 11: Total number of employees in the software sector in Serbia



Source: Statistical office of the Republic of Serbia (Labour Force Survey)

The highest number of employees is recorded in group 62.0 Computer programming, consultancy and related activities (table 21). In 2015, number of employees in this group represents 67,84% of total employment in software sector. Compound annual growth rate (CAGR) calculated for 6-year period per groups of software sector shows that the highest growth rate of employees was in 62.0 Computer programming, consultancy and related activities (14,2%) and in 58.2 Software publishing (10,5%).

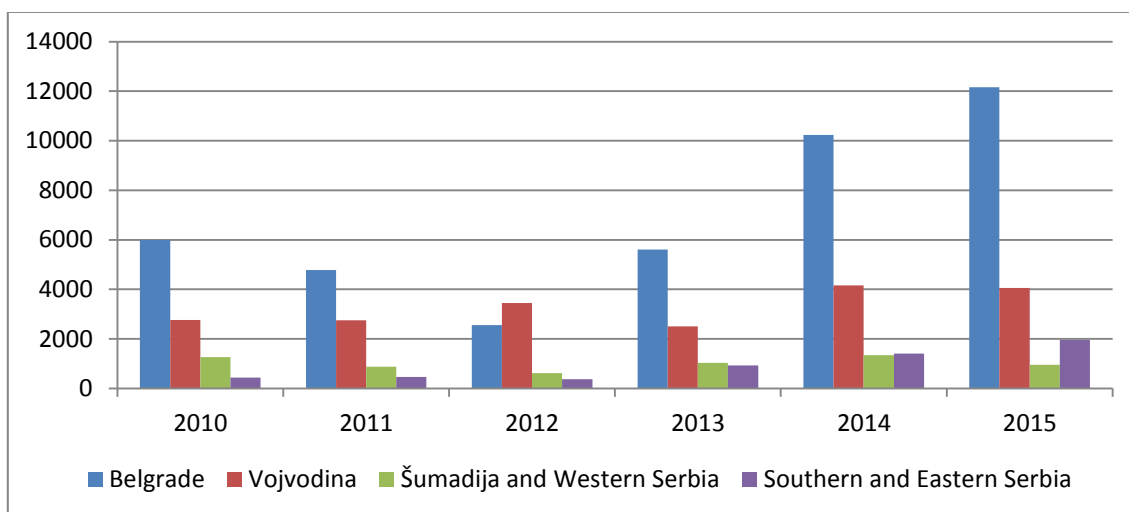
Table 21: Number of employees per groups of software sector

	2010	2011	2012	2013	2014	2015	CAGR (in %)
58.2 Software publishing	938	884	664	786	2434	1707	10,5
62.0 Computer programming, consultancy and related activities	5856	6467	5005	7149	12673	12993	14,2
63.1 Data processing, hosting and related activities; web portals	860	494	585	1184	709	1076	3,8
63.9 Other information service activities	2810	1028	755	953	1344	3376	3,1

Source: Statistical office of the Republic of Serbia (Labour Force Survey)

Regional distribution of employment in Serbian software sector indicates that the highest number of employees is in Belgrade region throughout the whole period except in 2012. It is interesting to note that in 2012 Vojvodina had higher number of employees in software sector than Belgrade region for about 887 workers, but turnover of the sector was higher in Belgrade for around 31,8 billion RSD. Regions of Šumadija and Western Serbia and Southern and Eastern Serbia have substantially lower number of employees than Belgrade and Vojvodina region. However, in the last 2 years of the observed period, it is visible a significant increase of employment in Southern and Eastern Serbia.

Figure 12: Regional distribution of employees in software sector in Serbia

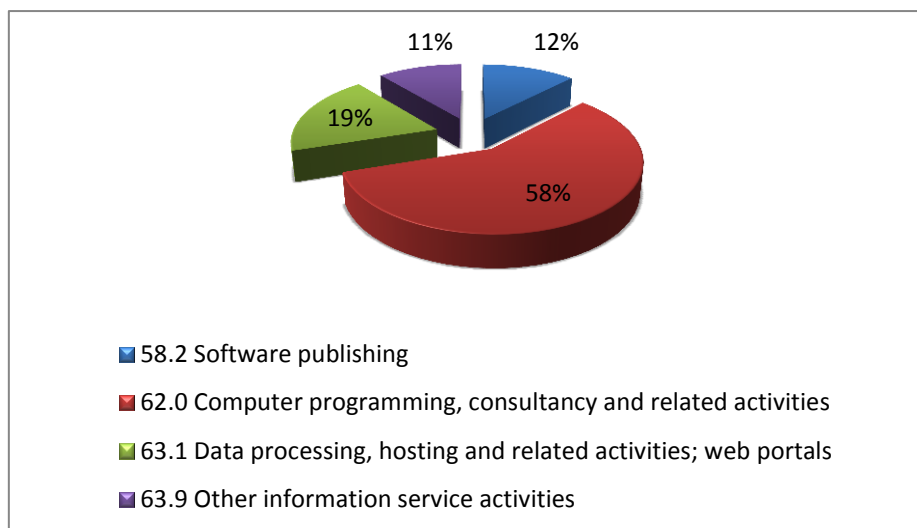


Source: Statistical office of the Republic of Serbia

In 2015, the highest share in total gross earnings of software industry has group 62.0 Computer programming, consultancy and related activities (58%) and 63.1 Data processing, hosting and related activities; web portals (19%).

Comparative analysis of employment in software sector in selected Danube Region countries is provided for group 62.0 as the most productive part of the sector (table 22). All selected countries, except Bosnia and Herzegovina and Slovenia in period 2013-2015 have higher number of employees than Serbia in group 62.0. However, according to the compound annual growth rate, Serbia had the highest growth of number of employed persons in the observed 6-year period. This indicator reflects growth potential of Serbian software sector.

Figure 13: Structure of gross earnings in software sector in 2015



Source: Statistical office of the Republic of Serbia

Table 22: Number of employees in group 62.0 Computer programming, consultancy and related activities

	2010	2011	2012	2013	2014	2015	CAGR (in %)
Bulgaria	23348	25119	28081	31172	33490	38273	8,59
Czech Republic	45396	48309	50798	52647	54631	57441	4,00
Croatia	9906	10746	11334	12388	13067	13956	5,88
Hungary	36472	38730	42187	43655	46537	51376	5,88
Austria	29315	32070	34409	36421	37815	39151	4,94
Romania	39319	43283	48304	53445	59089	71009	10,35
Slovenia	8477	8487	8564	8915	9013	9520	1,95
Slovakia	14795	20030	21115	19269	20448	23610	8,10
Bosnia and Herzegovina	n/a	n/a	2583	2643	2879	3554	n/a
Serbia	5856	6467	5005	7149	12673	12993	14,21

Source: Eurostat and Statistical Office of the Republic of Serbia

5.3 Export and import of software sector

Due to lack of export and import data, trade balance will be presented only for group 58.2 Software publishing. These data show unfavourable position of Serbia in international trade: in period 2012-2016 in all years, except in 2013, there was a negative trade balance (table 23). Therefore, Serbia was importing more software than exporting which had a negative effect on balance of payments of the country.

When observing trade balance of the group 58.2 Software publishing per regions (table 24), it is clear that negative result in international trade is characteristic for all regions and all years, except for Belgrade region in 2012 and 2013.

Table 23: Export and import of the group 58.2 Software publishing in Serbia (in EUR)

	Export	Import	Trade balance (+, -)
2012	1.263.415	1.977.242	-713.827
2013	1.192.312	1.160.958	+ 31.354
2014	438.446	1.450.204	-1.011.758
2015	714.618	2.020.430	-1.305.812
2016	398.234	842.129	-443.895

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

Table 24: Trade balance of the group 58.2 Software publishing per regions in Serbia (in EUR)

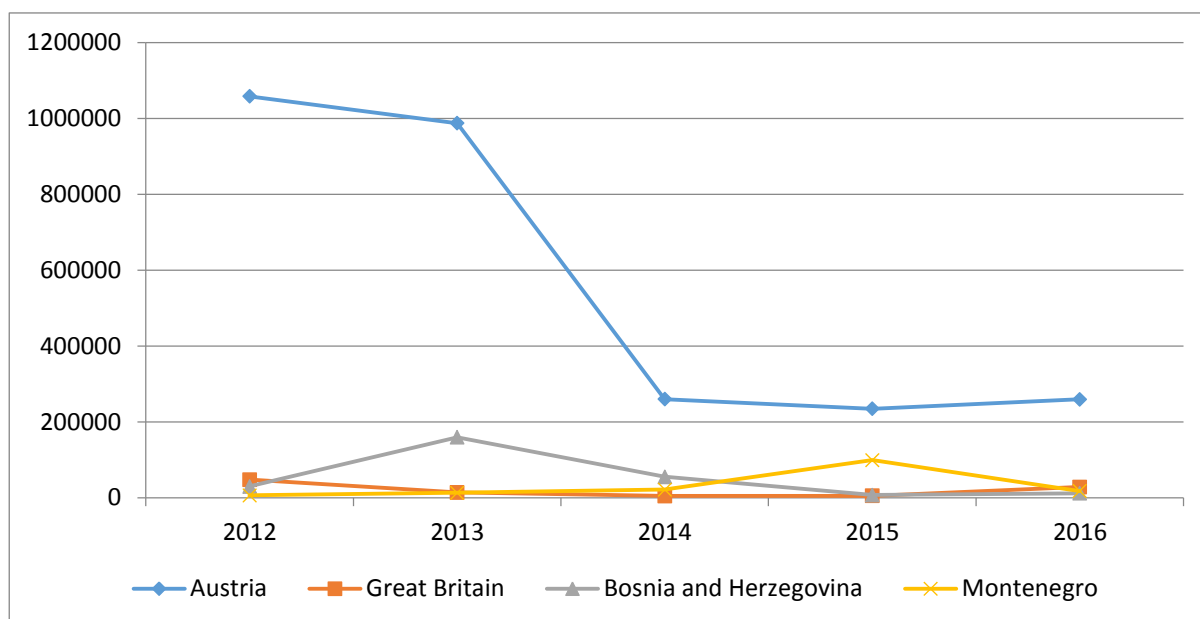
	2012	2013	2014	2015	2016
RS11: Belgrade	483537	114018	-873326	-1055180	-161261
RS12: Vojvodina	-1135217	-31091	-92680	-38814	-80672
RS21: Šumadija and Western Serbia	-48920	-14657	-29204	-189032	-188100
RS22: Southern and Eastern Serbia	-12706	-33502	-14254	-20916	-10625

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

In order to determine top exporting countries of software publishing (58.2) in Serbia, at first are for all years in period 2012-2016 identified 10 countries in which Serbia had the highest value of export. In the second step, among 10 countries are selected 4 countries which have high value of export in each year. These top exporting countries are Austria, Great Britain, Bosnia and Herzegovina and Montenegro.

As indicated in figure 12, Serbia has exported the most of its software publishing (58.2) services to Austria, although there is a decreasing trend in this line of international trade (from 1,1 million EUR in 2012 to 260 thousand EUR in 2016). On the other hand, export of software publishing services to Great Britain, Bosnia and Herzegovina and Montenegro was very variable in the respective period.

Figure 14: Top exporting countries of the group 58.2 Software publishing in Serbia



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

Relative position of Serbian software sector is presented in comparison to the following Danube Region countries: Bulgaria, Czech Republic, Croatia, Hungary, Austria, Romania, Slovenia, Slovakia and Bosnia and Herzegovina.

5.4 Export and import of computer services

According to the data of the National bank of the Republic of Serbia, computer services have become extremely important economic activity. The computer services sector has reached around 760 million EUR export in 2017, with net effect of 463 million EUR (table 25).

Table 25: Export and import of computer services in the Republic of Serbia

Computer services (millions of EUR)	2011	2012	2013	2014	2015	2016	2017	Ratio: 2017 / 2011
Export	170.888	221.287	295.832	344.416	454.736	589.820	759.716	444.57%
Import	126.774	149.280	160.819	172.343	166.902	193.325	296.288	233.71%
Balance	44.115	72.008	135.013	172.073	287.834	396.497	463.427	1050.50%

Source: National Bank of Serbia (NBS), http://www.nbs.rs/internet/english/80/platni_bilans.html

6. Concluding remarks

Serbia lacks integration of existing industry and institutions about large and ambitious projects. Serbia's market is quite probably below critical mass. Irrespective of this, this integrated approach is economically feasible – once this kind of ambitious project integration is set up at the country level it can relatively easily expand to the wider region, as well as to specifically target wider markets. This kind of process is necessary to stop further fragmentation of knowledge and expertise that has been going on for decades. On the other hand, the offshoot of this is that this knowledge has been relocated to (and substantially increased by) leading companies and countries. This diaspora is now a huge and virtually untapped developmental resource. The first country in the region to learn how to tap it will reset its economy and become the regional leader.

ICT is a generic sector and can be applied in all sectors. Regarding the current status, the potential of software industry is generally high because it can push forward not only the ICT sector but also the related branches of economy as well. The local IT market is underdeveloped and characterized by low demand for IT products and services. There appears to be a narrowly focused and concentrated pool of innovation resources and capacities centred around Belgrade, Novi Sad and Niš – i.e. major urban areas with higher overall volume of economic activity and presence of university and higher education institutions. The government should see how to use the potential of the software industry for the whole economy particularly, how to develop rural environment. There is an example of Biosens for Agriculture, but in general it should be an added value for all other sectors - the public sector, tourism, health, education, culture. There are demands, steaming from academy sector, as well as from industry sector. There is a large, tangible demand for ICT sector innovation financing (measured by total volume of applications and funds requested). There also appears to be a high market need for this as well, both locally and regionally.

It has been shown that remarkable growth of the software industry in Serbia over the previous decade has resulted in an increasing demand for human resources which exceeds the capacities of educational institutions. It is already been stated by stakeholders from this study that shortage of people is slowing down the future growth of this sector. This situation requires a coordinated set of actions by the government to respond to the sector's needs. Majority of respondents shared the same view on the top priority for change in the education system.

Current broadband infrastructure is unfavourable for the further development of the software sector in Serbia. The Serbian government should eliminate the interests of big players and put more efforts in order to create the better broadband infrastructure which is necessary to develop the Serbian domestic market for IT products and solutions. Government institutions are slow, inertia of the system. The way of thinking is still the same as in the former system. Better organization of administration at all government and non-government levels is indispensable.

The state needs to deal with ICT in order to enable this sector to move the economy forward. In the next 20 years, each branch will be based on technology. Manual occupations will probably disappear; creativity and scientific work will get a higher price. The banking industry already defines itself as a software company. The economy is transforming incredibly quickly. The changes are inevitable and the question is whether Serbia will keep up with the changes or not, and that is

the main issue for the state. It is not worthwhile to create incentives without eliminating barriers. Government should eliminate administrative and taxation burdens and to create more favourable regulation and financial framework.

Although there are some improvements in the last few years, there are still high number of software companies have been competing globally on the basis of the low cost of qualified human resources. This growth model is now in danger since the salaries in the sector grow and the advantage of the salary is becoming less important. The growth of the software industry in the countries of the region puts additional pressure on domestic companies to change the business model. The alternative for the software sector in Serbia seems to be to move to activities with higher added-value and start competing on the basis of innovation. Based on the current state and dynamics that has existed for several years, it is clear that in the coming period, outsourcing will be the prevailing business model of most companies in the software sector. The role of the state in this process is to support companies that develop their own solutions and thus motivate companies to change their business model. Additional important measure to support this sector is through large IT procurement.

The role of government in supporting this transition process is crucial. Their role in the process must be expanded through development of expert bodies and think tanks that would help policy makers to view the sector as a whole and from different perspectives. There are no priorities and vision of the future situation. It is important to have priorities and to stick to the priorities. Research and Innovation Strategy for Smart Specialization (RIS3) should play an important role in facilitating this transition. The implementation of RIS3 has to be focused around specific projects and practical activities that together can support this sector as well as the goals and objectives of the actors of the innovation ecosystem.

Annex 1 List of interviewed organisations and individuals in ICT-Software programming sector in Serbia

Interviews with main stakeholders:

a. Managers of the major companies

- Institut Mihajlo Pupin - Sanja Vraneš
- Infostud - Stefan Salom
- Ringier Axel Springer - Olga Marinković Maksimović
- Societe Generale - Vuk Kosovac

b. Leading researchers

- Institut Mihajlo Pupin - Prof Dr Sanja Vraneš, University of Belgrade
- ETF - Prof Dr Milo Tomasevic, University of Belgrade
- Dr. Aleksandar Bogojevic, Director of the Institute of Physics Belgrade, University of Belgrade
- Dr. Antun Balaz, Institute of Physics Belgrade, University of Belgrade
- Prof Dr Ivan Lukovic, FTN, University of Novi Sad
- Prof Dr Leonid Stoimenov, Faculty od Electronics, University of Nis

c. Government officials

- Innovation Fund Ivan Rakonjac, PhD
- Ministry of telecommunications - Irimi Reljin

d. Business organizations

- ZUMOKO.d.o.o.
- ARS electronic
- Levi 9
- TIAC
- VegaIT
- Institut Mihajlo Pupin
- BioSense
- Typhoon HIL d.o.o.
- 3Lateral d.o.o.
- NIRI 4NL d.o.o.
- Logik d.o.o.
- Irvas d.o.o.
- RTRK
- Mad Head Games d.o.o. Novi Sad
- NORDEUS, Beograd
- Schneider Electric DMS, Novi Sad
- Ringier Axel Springer Serbia, Beograd
- Symbiotica, Beograd

- SAGA
- PricewaterhouseCoopers d.o.o.

e. Supporting organisations

- BINS – Đorđe Ćelić
- VICT Cluster - Milan Šolaja
- ST Park Zvezdara – Gordana Danilović-Grković
- NI CAT Cluster - Goran Mladenovic

f. Other stakeholders

- Consultant – a lawyer Žarko Ptiček, PTICEK LTD, Belgrade