



JRC TECHNICAL REPORTS

The Potential of ICT in Serbia: An Emerging Industry in the European Context

Kleibrink, A., Radovanovic, N., Kroll, H.,
Horvat, D., Kutlaca D., Zivkovic, L.



This publication is a Technical report by the Joint Research Centre (JRC), the European Commission's science and knowledge service. It aims to provide evidence-based scientific support to the European policymaking process. The scientific output expressed does not imply a policy position of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use that might be made of this publication.

EU Science Hub

<https://ec.europa.eu/jrc>

JRC114209

EUR 29558 EN

PDF ISBN 978-92-79-98369-6 ISSN 1831-9424 doi:10.2760/994464

Luxembourg: Publications Office of the European Union, 2018

© European Union, 2018

The reuse policy of the European Commission is implemented by Commission Decision 2011/833/EU of 12 December 2011 on the reuse of Commission documents (OJ L 330, 14.12.2011, p. 39). Reuse is authorised, provided the source of the document is acknowledged and its original meaning or message is not distorted. The European Commission shall not be liable for any consequence stemming from the reuse. For any use or reproduction of photos or other material that is not owned by the EU, permission must be sought directly from the copyright holders.

All content © European Union 2018, except cover image: © nitsawan – Adobe Stock.

How to cite this report: Kleibrink, A., Radovanovic, N., Kroll, H., Horvat, D., Kutlaca, D. and Zivkovic, L., The Potential of ICT in Serbia: An Emerging Industry in the European Context, EUR 29558 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-98369-6, doi:10.2760/994464, JRC114209.

Contents

1 Introduction - ICT in Europe and in the Western Balkans	6
2 Growth of the ICT industry in Serbia	6
2.1 Rise of employment in the ICT industry	10
2.2 ICT skills in the international setting	12
2.3 Innovation in the sector	13
3 Competitiveness of the ICT sector	14
3.1 SWOT analysis	14
3.2 Main challenges	15
4 The way forward	15
5 Conclusion.....	17
References	19
List of abbreviations and definitions.....	21
List of boxes.....	22
List of figures.....	22
List of tables.....	22

Authors

Kleibrink Alexander - European Commission, Joint Research Centre, Seville, Spain

Radovanovic Nikola - European Commission, Joint Research Centre, Seville, Spain

Kroll Henning - Fraunhofer Institute for Systems and Innovation Research ISI, Karlsruhe, Germany

Horvat Djerdj - Fraunhofer Institute for Systems and Innovation Research ISI, Karlsruhe, Germany

Kutlaca Djuro - Institute Mihajlo Pupin, Belgrade, Serbia

Zivkovic Lazar - Institute Mihajlo Pupin, Belgrade, Serbia

Abstract

The Information and Communication Technologies (ICT) industry is widely recognised as one of key driving forces of contemporary competitiveness. Inside the European Union, ICT are not only seen as a strategic sector, but also as a means to create positive spillovers to other economic sectors and achieve cross-innovation. Under this objective, the European Union supports the enhancement of the ICT industry potential in the Western Balkans, which was recently underlined with the adoption of the Digital Agenda for the Western Balkans. Within this region, Serbia has recorded the strongest growth. The Serbian government recognised digitalisation as priority. However, the environment of the ICT industry in Serbia, mostly referring to regulatory, political and educational frameworks, still needs to be improved. This paper analyses the status quo of the ICT industry in the Western Balkans with a focus on Serbia. It discusses the main challenges and proposes development paths with specific measures to be taken.

1 Introduction - ICT in Europe and in the Western Balkans

The importance of the ICT sector for the European economy is substantial. It represents 4.8% of the entire European economy, generates 25% of total business expenditure in research and development, while the investments in ICT account for 50% of all European productivity growth.¹ The development of the ICT sector correlates with the development of other industries in Europe. In that sense, the potential and capabilities of modern information systems are still growing exponentially fuelled by the progress in electronics, microsystems, networking, the ability to master increasingly complex cyber-physical systems and robots, and progress in data processing and human machine interfaces. These advancements provide major opportunities for Europe's competitiveness and contribute to a future-oriented economy by creating jobs and supporting growth.

Exploitation of the potential of ICT for fostering innovation, economic growth and progress is a part of the EU Digital Agenda, which represents one of the seven pillars of the Europe 2020 strategy setting the objectives for the growth of the European Union by 2020. Europe's intention is to invest in world-class ICT research and innovation and to enhance its competitiveness on the global arena of ICT research and digital innovation. By scaling-up the ICT innovation ecosystem in Europe, the objective is to improve innovation in Europe by providing instruments that facilitate entrepreneurial activities.

As is the case in the EU, the ICT industry plays an important role for the future growth of the Western Balkan economies. It ranks high on the agenda in all of the economies and its development is emphasised as one of the key objectives in strategic documents in the region. As part of the initiative to strategically enhance the ICT industry in the Western Balkan, the EU launched Digital Agenda for the Western Balkans in June 2018, in which the European Commission and six Western Balkan economies committed themselves to a set of measures. Under the hypothesis that ICT underpin innovation and competitiveness across private and public sectors and enable scientific progress in all disciplines, one of the key measures within the Digital Agenda is to expand research and innovation by setting up national research facilities and developing state-of-the-art infrastructures in the region, so that they are better integrated with the digital European Research Area.

Serbia is by far the largest economy of the Western Balkans with the total GDP of EUR 34.6 billion in 2016, according to the EUROSTAT data. While many indicators show the growing importance of the ICT sector in the Serbian economy, there is a need to evaluate industry performance, its main trends and key challenges in terms of future development plans, particularly taking into account the strategic position of the industry for the country's competitiveness. This report assesses the potential of the ICT Serbian industry, taking into consideration the internal industry constituents, the growing trend of internationalisation, and the match of skills and education with the actual market needs. For this we use the results of a comprehensive firm survey, findings from a multi-stakeholder innovation camp held in 2017, a SWOT analysis, and the additional analysis of various indicators in regard to the Serbian ICT sector.

2 Growth of the ICT industry in Serbia

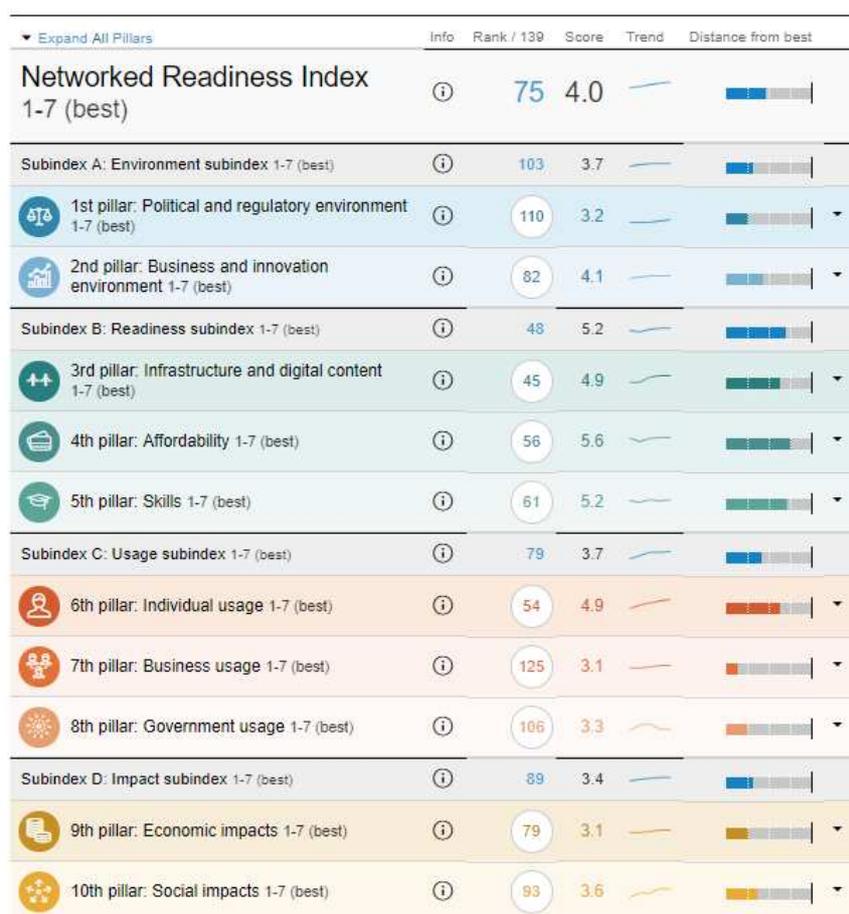
Concerning how well countries are doing in the digital world, the Western Balkan region is lagging behind the European Union. According to the World Economic Forum's 2016 Global Information Technology Report, based on an Executive Opinion Survey, Western Balkan countries reach a networked readiness index value of 4.0 out of 7.0. The networked readiness index measures how well an economy is using information and communications technologies to boost competitiveness and well-being. According to the study, the most notable weaknesses are found in the areas of political and regulatory

¹ <https://ec.europa.eu/programmes/horizon2020/en/area/ict-research-innovation>

environment, business ICT usage and government ICT usage. The level of the Western Balkan countries in this relation is notably lower than of the EU member states.

Serbia's index is 4.0 (see Figure 1), which is similar to the Western Balkans average and to that of neighbouring Albania, Bulgaria, Greece, Romania and Turkey. It lags notably behind lead nations like Germany (5.6), the United Kingdom (5.7), the United States (5.8), but also behind Slovenia (4.7), Hungary (4.4) and Croatia (4.3). Accordingly, the sector's economic and social impacts remain below average as well (World Economic Forum, 2016).

Figure 1. World Economic Forum's 2016 Global Information Technology Report



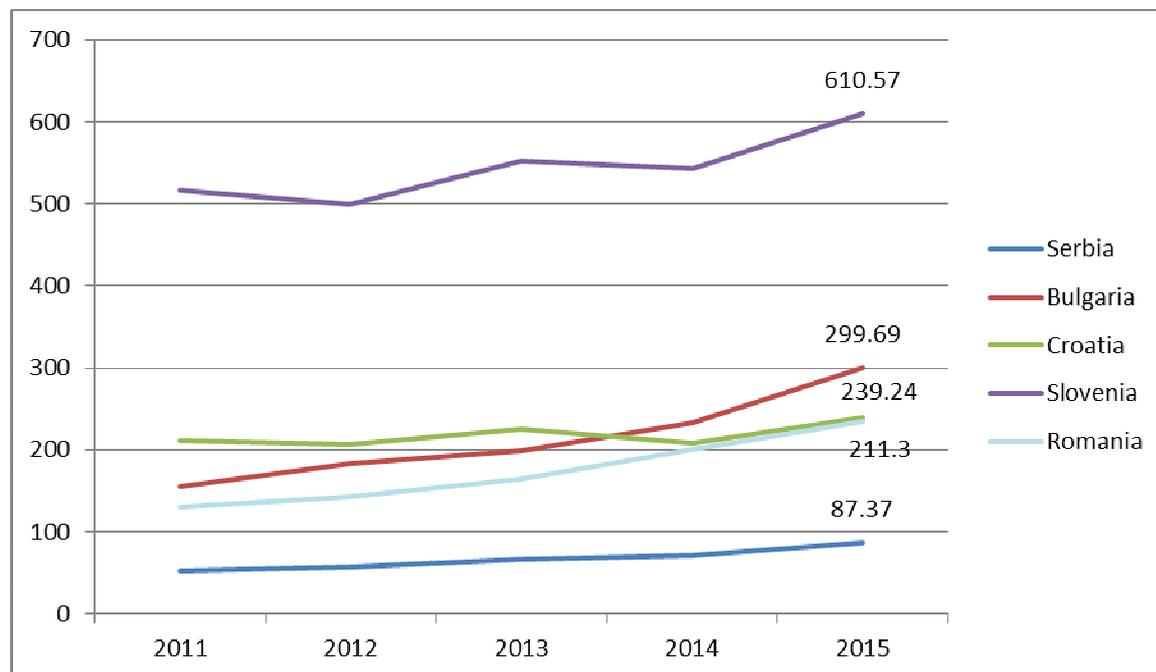
Source: World Economic Forum 2016 Global Information Technology Report

However, there are many indicators which demonstrate the growth of the ICT industry in Serbia and even signal the surge of the Serbian ICT sector on the global competitiveness arena.

The ICT in Serbia market was estimated at EUR 1.73 billion in 2016. It is the fastest growing sector in the last decade, accounts for 6 per cent of country's GDP and generates international visibility for the Serbian economy (Serbia Business, 2018). As in all countries from the South-East Europe, this sector in Serbia is strongly export-oriented with most of the companies targeting international markets. The exports of ICT sector in Serbia reached a record EUR 900 million in 2017, with the increase of 21.5% from the year before. ICT services export was higher than exports in traditional industries and it was only exceeded by the exports of electric machines and road vehicles which amounted to more than EUR 1.2 billion (Central European Financial Observer, 2018). In the period from 2011 to 2015, the total turnover of the software sector in Serbia has almost doubled, with the majority of activities being related to computer programming, consultancy and related activities (Kutlaca et al, 2018). The ICT sector is recording approximately 25% year-to-year growth rate, putting the industry in the highest ranking

growth tiers in the country (Digital Knights, 2018). Although the growth is sharp, Serbia is still lagging behind similar countries in the region (Figure 2).

Figure 2. Total turnover of software sector per selected countries from 2011-2015 (in million EUR, per million inhabitants)



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

Some authors suggest that the ICT sector in Serbia demonstrated rapid growth and strong potential in recent years, providing a push for the growth of other sectors as well (Katic et al, 2013; see also Domazet and Lazic, 2017). While there is a consensus that the potential exists, its full realisation is yet to be pursued. However, such processes of upgrading in the ICT global value chain have proven successful in other emerging ICT countries (Chaminade and Vang, 2008). A study by the European Commission (2018) shows that Serbia has had the highest export shares of ICT goods and services among the Western Balkan economies (see Table 1).

Table 1. Export of ICT goods and services of the Western Balkan economies

	ICT goods export (% of total goods exports), 2008-2016 average	ICT service export (% of service exports, BoP), 2008-2017 average
Albania	0.51	11.44
Bosnia and Herzegovina	0.19	8.57
Kosovo*	N/A	15.15
FYR of Macedonia	0.41	24.68
Montenegro	0.46	8.38

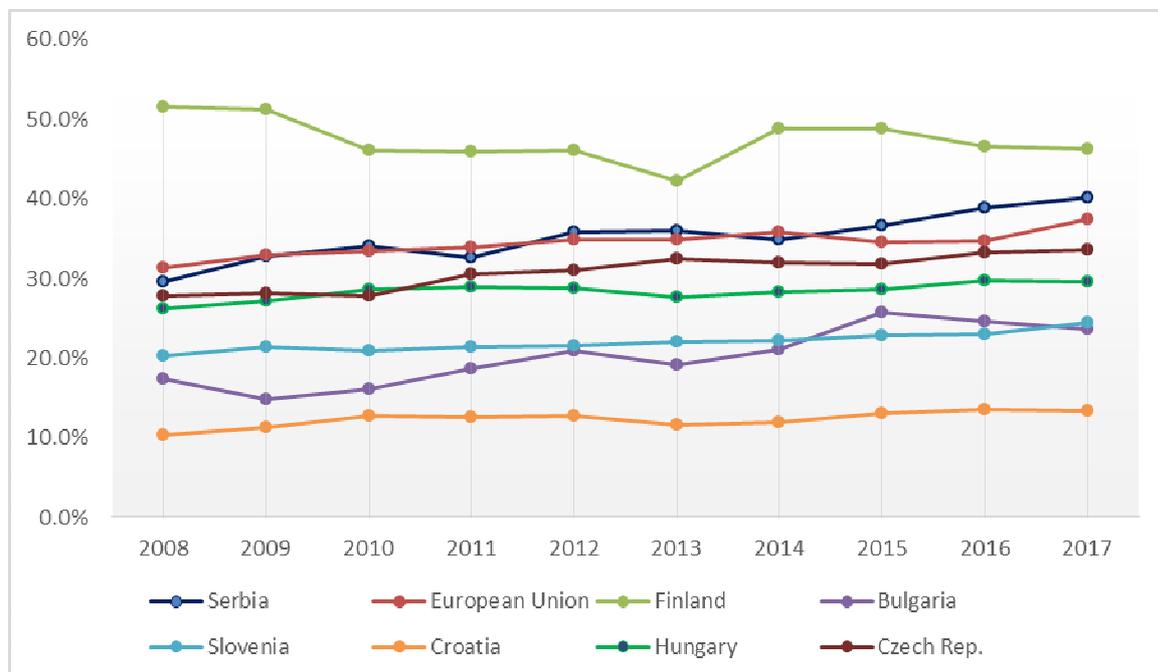
* This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

Serbia	1.67	35.15
EU	5.63	34.38

Source: European Commission, 2018

Data on ICT service exports from 2017 put Serbia on top of most European countries. With the share of ICT service export encompassing more than 40% of all service exports, Serbia ranks higher than any of the EU-13 countries, as well as of the EU average (Figure 3). Among the EU-13 countries, Serbia is followed by Romania (39%), Czech Republic (34%), Poland (33%) and Slovakia (33%). Only five EU countries fare better in this regard – Ireland (67%), Belgium (48%), Finland (46%), Sweden (45%) and Germany (41%). However, in comparison to those high-performers, Serbia's relative growth of the ICT service exports in relation to all service exports in the last ten years (26.7%) was only the second highest to Belgium (33.29%).

Figure 3. ICT service exports (% of service exports, BoP), Serbia vs selected EU countries, 2008-2017



Source: World Bank data

Strong performance of the ICT sector in overall exports results indicates the high capacity for quality production in the Serbian ICT sector. This also demonstrates the economy's orientation towards enhancing creativity and capability to answer to the ever-growing demand for very diverse solutions that the ICT industry is providing today.

While these results reveal the dominance of the export orientation among Serbian ICT firms, they also raise questions about the potential of the ICT industry to support growth of the economy at large. As most of the Serbian ICT firms develop business models for foreign markets, either in cooperation with foreign companies or directly for international customers, the ICT sector currently plays a limited role for the development of other domestic sectors and makes a more limited contribution to national economic upgrading than desirable (World Economic Forum, 2018). In order to increase the cross-cutting impact of the ICT sector, a dialogue with other industries and their key players is needed. On the positive side, the ICT sector is more potent than other industries in involving experts from diaspora in the enhancement of the country's economic potential, having in mind low impact of geographical distance on the development of the ICT industry.

Box 1. Cross-cutting dimension of the ICT sector: BioSense Institute

BioSense Institute from Novi Sad, Serbia, is using a multidisciplinary approach in creating breakthrough products and services in the ICT area for advancements in other sectors, most notably in the agriculture. Multidisciplinary research is performed in the fields of micro- and nanoelectronics, communications, signal processing, remote sensing, big data, robotics and biosystems, with a common goal to support the development of sustainable agriculture. In that sense, it integrates ICT solutions to provide information to the agricultural sector. The final goal of BioSense is to incorporate all efforts and results of various research groups into a unique BioSense integrated system for agricultural monitoring. BioSense Institute has coordinated or participated in a large number of international research projects, including Horizon2020, FP7 and Eureka.

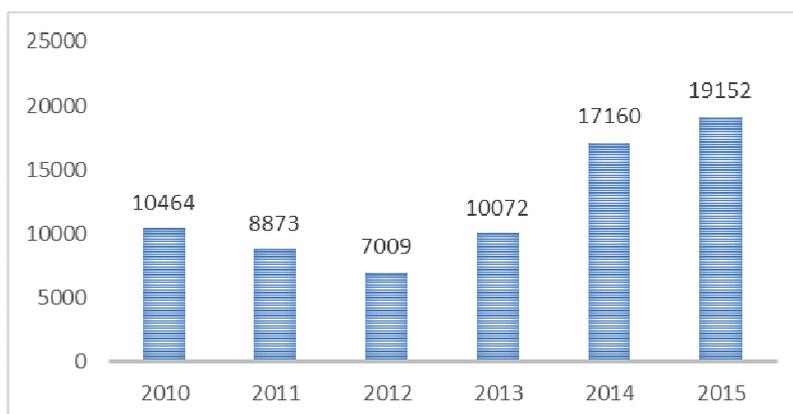
The Government of Serbia identified the IT industry to be among economic priorities for country's competitiveness and considers how to further develop the industry. The action plan of the "Strategy for Development of the IT Industry for 2017-2020" foresees investments into retraining, infrastructure development and improving the business environment. The Government of Serbia seeks to develop human capital, establish innovation infrastructure, create a competitive market and secure financial incentives for the ICT industry. In the Plan of priority actions of public administration for improving IT sector in Serbia (Government of the Republic of Serbia, 2017), the Council for innovative entrepreneurship and information technologies emphasizes several crucial indicators of significance for the Serbian economy: the sector employs more than 40 000 people, it generates annual income of more than EUR 4 billion, and the average salary in the ICT sector is almost two times higher than the average salary in other industries. Under the objective of increasing the number of trained IT experts on the market, in 2018 the government intends to additionally train the teachers of IT in primary and secondary education institutions, as well as to extend quotas on IT subjects in higher education.

In the following five-year period, government plans to reach EUR 1.5 billion in IT sector net exports, to increase the number of the output of skilled IT workers to 5 000 per year (from current 1.500) through formal and informal education, to invest into physical infrastructure of the IT centres in Serbia (mainly within universities) and to modify the legal framework related to early stage investments, electronic payments and venture capital, also by introducing tax reliefs for business angels and reviewing subventions to the IT industry. The mentioned document also stipulates the adoption of the new law on alternative investment funds, primarily focusing on regulating activities of venture capital funds, and enabling of crowdfunding platforms. The support will also come for endeavours of developing new science and technology parks in additional four cities and strengthening capacities of research institutes in developing high-tech products and cooperating with the business sector.

2.1 Rise of employment in the ICT industry

In the period from 2013 to 2017, the total number of employees in the ICT sector recorded an upward trend. According to Kutlaca et al. (2018), employment increased by 57% in a 5-year period. Although the number of employed persons in the software sector was modest in comparison to total number of employed people in Serbia, the number almost doubled from 2010-2015, rising to 19 152 in 2015. Based on the NACE Rev. 2 classification of economic activities, most of the companies are active in the field of computer programming, consultancy and related activities (more than 60%), followed by the companies active in data processing, hosting and related activities, web portals and software publishing. There is a strong base of programmers in Serbia, but capacities need to be further developed in specific areas, such as internet marketing. Around 84% of all current ICT employees hold a university degree and more than 80% of them work in the field of software development.

Figure 4. Total number of employees in the software sector in Serbia, 2010-2015



Source: Statistical office of the Republic of Serbia (Labour Force Survey), 2017

In regard to employment, the estimation of the Vojvodina ICT Cluster was that between 2016 and 2020 there could be approximately 30 000 new jobs opened by IT start-ups in Serbia, primarily related to offering cloud solutions to the public sector as well as to small and medium businesses. The development of the industry has a strong regional component, as the Belgrade ICT sector (and, to a certain extent, the region of Vojvodina) contributes significantly to value added and growth, and pays higher wages than elsewhere in the country. The country recorded huge regional disparities in the distribution of software sector turnover between the northern and the southern parts of Serbia, with the turnover in Vojvodina and Belgrade (northern part) standing around 20 times higher than the turnover in the regions of Sumadija and South-Eastern Serbia (southern part) in the period 2010-2015. The overall role of hardware production, on the other hand, remains relatively small, although apparently characterised by a large number of smaller firms. Despite the fact that Serbia does not yet play a substantial role in the global ICT value chain, it has developed into one of the leading ICT locations in the Western Balkans, a position on which it can build and which it should further develop.

The comparative analysis of employment in computer programming, consultancy and related activities in the software sector in selected Danube Region countries (see Table 2) demonstrates that Serbia recorded the highest growth in this area, illustrating the potential of the sector in terms of employment growth.

Table 2. Number of employees in group 62.0 Computer programming, consultancy and related activities

	2010	2011	2012	2013	2014	2015	CAGR (in %)
Austria	29 315	32 070	34 409	36 421	37 815	39 151	4.94
Bosnia and Herzegovina	n/a	n/a	2 583	2 643	2 879	3 554	n/a
Bulgaria	23 348	25 119	28 081	31 172	33 490	38 273	8.59
Czech Republic	45 396	48 309	50 798	52 647	54 631	57 441	4.00
Croatia	9 906	10 746	11 334	12 388	13 067	13 956	5.88
Hungary	36 472	38 730	42 187	43 655	46 537	51 376	5.88
Romania	39 319	43 283	48 304	53 445	59 089	71 009	10.35

Serbia	5 856	6 467	5 005	7 149	12 673	12 993	14.21
Slovenia	8 477	8 487	8 564	8 915	9 013	9 520	1.95
Slovakia	14 795	20 030	21 115	19 269	20 448	23 610	8.10

Source: Eurostat and Statistical Office of the Republic of Serbia

Nowadays, software companies in Serbia employ approximately 20 000 people. Some of them are well-known internationally, such as Nordeus, Seven Bridges and Devana Technologies. Also, there are several very active IT hubs in Serbia. The most famous are StartIT, ICT Hub, Impact Hub and Business Incubator Novi Sad. The plan of StartIT hub to educate 100 000 young leaders across 12 cities in Serbia by 2020 got the strongest backing in the history of crowd funding campaigns in the region. As the entrepreneurship system further develops through formal and informal education, more successful Serbian enterprises should be expected to appear in the future.

2.2 ICT skills in the international setting

High-tech firms seek knowledge sources and opportunities worldwide (Bartlett and Ghoshal, 1990; Dunning, 1994). They do this by, for example, locating R&D centres and sourcing technology and knowledge abroad. At the moment, Serbia stands at the periphery of the ICT global innovation network (Nepelski and De Prato, 2017). However, Eastern Europe has become one of the global IT outsourcing strongholds with the constantly increasing number of skilled programmers and software developers. Within this region, Serbia is seen as one of the most attractive markets for outsourcing IT services, mostly based on the professional abilities and knowledge and, to a certain extent, on the lower hourly rate. The Serbian market has been interesting to global ICT firms for a long time. There are signs of a possible trend of establishing IT development centres in Serbia, with certain global players, such as Microsoft, Cisco Systems and Asseco, setting up businesses and employing many domestic IT engineers in Belgrade. Others have also followed the suit, either by establishing their own development centres in Serbia or by outsourcing services to local IT companies.

Skills in ICT are gained from 35 higher education institutions in Serbia and each year there are more than 1 500 graduates in IT from universities across the country. The Global Information Technology Report 2016, published by the World Economic Forum, puts quality of the Serbian educational system on quite low 110th position out of 139 ranked countries. However, in regard to the quality of math and science education, Serbia ranks 48th (World Economic Forum, 2018). Thanks to the educational system being significantly focused on engineering and computer sciences, Serbia creates highly qualified and very capable young people with strong mathematical and logical background focus. IT professionals have extensive expertise in developing front-end, back-end and middle-ware components, and are also proficient in understanding client requirements and creating tailored software and systems solutions. There are evidences that faculties are constantly developing new IT programmes and their own capacities for new students. However, high growth of the ICT sector in Serbia, combined with the increased hiring by big global IT companies in Serbia, resulted in the lack of senior ICT experts. The competition for experienced employees is strong and affects the sector in a negative way.

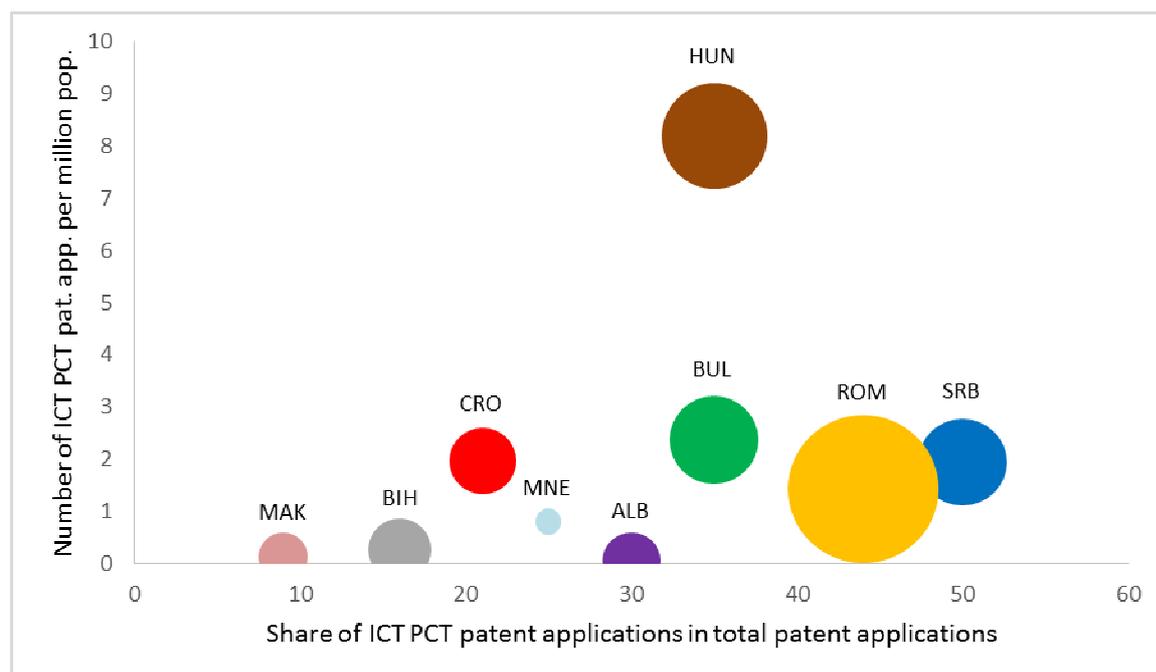
The salaries are considered not to be high in comparison to other regions in Europe, but are on a constant increase in average. Also, English language skills are considered to be beneficial for the external market. The proficiency in English language for Serbian people has been on a high level for several years now. In this regard, Serbia is ranked 18rd globally and is among the countries having high proficiency level of English language (EF Education First, 2018).

2.3 Innovation in the sector

Innovations in the ICT domain are important factor for the European economy. The ICT-related innovations represent between 17% and 26% of the total innovative output in the EU. With its annual R&D expenditure of EUR 27 billion (2009), the ICT industry represents 17% of the total European Business Expenditure in Research and Development (BERD).³

In regard to the innovation potential of the Serbian ICT industry, there is a room for development. Currently, there are more than 2 700 innovative ICT companies in Serbia. Based on the patent analysis, ICT-related patent applications make approximately 15% of all domestic patent applications, which is a higher share than in Croatia (12%), but lower than in Hungary (21%), Bulgaria (32%) and Romania (33%)⁴. By the count of ICT PCT patent applications per million population, Serbia performs far better than other Western Balkan countries. With Serbia having this indicator at 1.94 in 2016, the closest performance in the Western Balkan region came from Montenegro with 0.80 patent applications per million inhabitants, according to the World Bank data. Serbia went up by 52 in rank in regard to the ICT PCT patent applications per million inhabitants from 2012 to 2016. Its latest rank is 44 out of 103 countries for 2016. Comparison to the Western Balkan and surrounding EU countries is given in the Figure 5, which shows the relation between the number of ICT PCT patent applications per million inhabitants (*y-axis*) and the share of the ICT PCT patent applications in total PCT patent applications (*x-axis*), relative to the total population number represented here with the size of the bubble.

Figure 5. ICT PCT patent applications in 2016, Serbia vs. surrounding countries



Source: Authors' calculation based on the World Bank data

According to the survey by Institute Mihajlo Pupin in 2017, more than 70% of companies responded that they have introduced an innovation in the last 7 years and 60% stated that they carry out their own research and development efforts. On the other hand, cooperation within the R&D sector in the country is on a low level, as only one third of the companies reported that they collaborate in this manner. Research efforts in faculties and institutes suffer due to insufficient funds available but also due to poor management. Although there are demands for innovation from the market, research

³ <https://ec.europa.eu/jrc/en/research-topic/ict-rd-and-innovation>

⁴ Analysis has been performed with the use of the PATSTAT tool of the European Patent Organisation

efforts are not adequately directed, whilst prioritisation and organisation elements are also on inadequate levels. Since ICT is the most dynamic sector and presuming that innovative start-ups play important role here, support needs to be directed to this layer of the economy. Policy measures which would help developing innovation output include access to finance, provision of fiscal incentives and direct support for R&D.

3 Competitiveness of the ICT sector

The most important sources of companies' competitive position in the software industry in Serbia are specialised expertise, programming skills, reputation and quality products and services. In addition to this, strengths also come from good price-quality ratio (with a view to average wages) and cultural proximity to European clients.

The most of the ICT companies in Serbia define workforce as highly qualified, well-educated and having innovative spirit. Other main strengths include labour cost, companies' flexibility, language skills and cultural similarities with the West. The prices of the services offered by the software companies in the global market are highly competitive, having in mind acknowledged quality, excellent coding competencies and established reputation. Combined with agility and flexibility of IT experts, a good command of the English language and a higher degree of cultural proximity to the Central Europe than other outsourcing destinations, these attributes provide Serbia with strong boost in terms of international competitiveness.

3.1 SWOT analysis

The following table gives an overview of the SWOT analysis of the potential of the ICT industry in Serbia, performed by the Fraunhofer Institute for Systems and Innovation Research ISI.

Table 3. Overview of the SWOT analysis of the potential of the Serbian ICT industry

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> - attractive prices on the global market in combination with good and acknowledged quality; - excellent coding competencies; - long-established reputation; - agility and flexibility; - good level of English skills and a higher degree of cultural proximity to Central Europe than other outsourcing destinations. 	<ul style="list-style-type: none"> - lack of qualified personnel, in particular of senior project managers; - capability issues with respect to non-technical competences (management, marketing); - limited availability of (risk) finance; - networking issues (with science and local economy); - basic regulatory and legislation issues ("grey economy"); - inadequate tax system.
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> - high and growing demand on the global market; - outstanding position of the Serbian ICT sector in the West Balkan region; - increasing awareness and support of the Serbian government; - gradual change in culture for greater support to small businesses and entrepreneurship. 	<ul style="list-style-type: none"> - business culture not (yet) supporting small businesses and entrepreneurship; - general lack of trust in the government; - external brain drain and loss of qualified staff to higher-paying MNC subsidiaries; - lack of coordinated support for ICT by the Serbian government; - inadequacy of funding support measures; - limited leverage to affect international market forces.

3.2 Main challenges

During the Software Innovation Camp in Belgrade in December 2017, the dialogue among stakeholders has pointed out several main challenges on the ICT industry:

1) Lack of skilled labour force in conditions of ever-increasing demand

Even with the described surge of employment in the ICT sector, Serbia experiences lack of qualified labour force, i.e. developers and designers. Combined with the risk of IT experts' fluctuation, it is clear that the country needs to enhance capacities in this respect.

2) Inadequate institutional setup for supporting software industry

Although the software industry and the ICT sector as a whole already play important role in the Serbian economy, institutional capacity is not following its growth. As there are different relevant strategies adopted, such as the Strategy for information society and the Strategy for digital skills, the difficulties in implementing strategic actions come from infrastructural deficiencies. For example, this sector is characterised by the engagement of a large number of freelancers whose legal status is not regulated. Also, one of the important issues in this regard is that export activities and e-commerce suffer due to poorly regulated legal framework and financial transactions limitations. High expenditure on taxes and contributions, unfavourable conditions on the domestic market and the lack of funds for development were all marked as key constraints for the development of the companies. In addition, other administrative issues, such as inadequate regulation for taxation and difficulties in registration of entities, result in a growing number of unregistered entrepreneurs and companies registered abroad, which still constitute the Serbian ICT sector.

3) Lack of dialogue between companies, academia and government

There is a need to strengthen intermediaries (e.g. clusters) to effectively contribute to a continuous dialogue between companies, universities and government. Issues arise with the evident lack of trust and differences in vocabularies used between the companies and the government. Weak connection between the industry and the academia leads to the general low interest of IT businesses for collaboration with the universities in joint research efforts.

4) Inadequate positioning of the software industry in the Serbian economy and society

The software industry needs to be better integrated into Serbia's economy and society. The strategic orientation of the government to support the ICT sector cannot be successful if the industry is not diffused through all levels of the economy and society. The ICT sector is generally suffering from weak marketing and branding efforts by relevant national institutions. This is connected to the low visibility of the companies which operate in this industry.

4 The way forward

It is clear that the ICT industry in Serbia is experiencing high growth in terms of profit, employment and exports and is becoming one of crucial drivers of the national economy. Based on the achievements of the ICT sector, Serbia became a reputable regional player who even performs well on the global arena. In order to maintain this growth, the country needs to further improve the environment where ICT entities operate. Main work, according to the analysis by the Mihajlo Pupin Institute, needs to be done in the areas of increasing quotas for software engineering at universities and modernising curricula, as well as advocating stronger entrepreneurial skills. At the performance level, key actions should be addressed at strengthening the financial instruments available to new businesses, institutionalising support to the ICT sector and increasing the complexity of the ICT products.

Education. Although there is a constant growth of the graduated IT specialists, the output needs to be further increased to meet the market demands. Certain modifications need to be introduced in the university curriculum, where the education should be able to provide greater and deeper knowledge of the IT engineering. In line with this goal, programming should be introduced at the earlier stage, in elementary education. As part of the informal education measures, public support should be streamlined towards the provision of on-the-job training opportunities. This action would broaden the scope of the ICT skills of employees across industries. In order to put the emphasis on the business orientation and cross-cutting possibilities of the studies in ICT domain, an option would be to include introduction of formal industrial doctorate studies as a collaborative effort of companies and faculties. Industry-driven and project-based learning and research activities could provide better equipped talents who would be able to apply solutions to different types of industries. Also, national ICT competitions for different levels of education with the clear focus on multidisciplinary nature of the ICT industry could assist in this manner. The abovementioned measures could improve the offer of talented people with the IT background to the market. In addition, the interlinkage with other industries would endorse multidisciplinary observation by the youth. Basic knowledge of ICT provided at the early age should enable students to grasp the benefits that the ICT brings to all other branches of industry. In order to improve the positioning of the software industry in the society, it is also necessary to complete a reform of the educational system in accordance with the market needs and to have a better flexibility for the use of innovation potential. Planning of governmental support to the ICT industry should therefore include a roadmap for digitalisation and reform of the educational system to accommodate needs for matching needed ICT skills. For the efficiency sake, funding priorities need to be result-driven.

Marketing. Activities of the ICT sector are still under surface, failing to match the mainstream favoured sectors like automotive or agricultural industries. Visibility of the companies in the ICT sector should be enhanced by the government measures. This could be enhanced by a national ICT branding scheme, to build on the elements of the existing international recognition. However, most of the marketing efforts should come by firms themselves and by the support and expertise of the ICT clusters in Serbia. Enhanced collective branding efforts play important role in the international market as well. Here, intensified networking through clusters and other networks will lead to enhanced international recognition and competitiveness.

Institutional support. Institutional support should aim at increasing vitality of the business ecosystem by bolstering collaboration between domestic firms and also by negotiating domestic capacity building measures in endorsing foreign investments in the ICT sector. Competitiveness of both public and private domestic IT companies needs to be enhanced by the upgrade of IT capacities and by efficient barrier-free legislation system. Here, more efforts should be invested into enforcement of the existing regulation. Support in this area can come from the adaptation of the tax system to the nature of small firms and start-ups doing business. It can also come by allowing profit tax exemption to start-ups up to certain levels of profit achieved. Regulation should also allow crowdfunding option, especially for start-ups in this area. The assistance for ICT firms can also come with the setup of subordinate development agencies with such capacities. In addition, improvement of the legal framework for e-commerce and foreign payments could facilitate increased profits from exports, enhanced possibilities for investments into ICT sector and better regulated e-commerce activities.

Lack of communication between companies, academia and government. Joint research and development activities between businesses and public research institutions in the ICT domain suffer from a lack of communication. The ongoing entrepreneurial discovery process (EDP) within the development of the Research and Innovation Strategy for Smart Specialisation (RIS3) of Serbia has the capacity to enable cooperation between different stakeholders, where also the subsequent RIS3 should showcase the real needs of the business sector. The main support needs to come from the

governmental institutions which should facilitate the entrepreneurial discovery process for the ICT as well as for other selected priority industries. Another type of support could come from sharing of equipment and human resources between these stakeholders, mostly with the direction from the research institutes to businesses.

5 Conclusion

Based on the networked readiness indicators, the Serbian economy is not fully using its ICT capacity to increase country's competitiveness. There is a need to enhance political and regulatory environment and the impact that the ICT industry exercises to the economy. On the other hand, the ICT industry in Serbia dominates the export of services in comparison to other sectors of the economy. Since the companies are orientated towards exporting their services, domestic market is scarcely influenced by the growth of the ICT sector. There are insufficient incentives for business re-orientation for facilitating domestic market at present. One of the means which could help facilitating shift in this direction is to provide assistance in bridging modern IT concerns, such as the digitalisation. The country should finance projects which help in enhancing IT capacities in the public sector and domestic industry that will be facing challenges of the digitalisation, possibly through public procurement. This measure would have a two-fold proceeding: it would help strengthening the national economy and it would trigger the development of a domestic market for the Serbian ICT firms.

The education and training offer at Serbian universities is improving but the state needs to provide sufficient means to further support its improvement. There is a substantial need for training in managerial and advanced technical skills. As hiring of external staff at that level of seniority will remain difficult, public support should be provided for on the job training offers, including the option of inviting international trainers or sending Serbian engineers abroad.

In spite of the fact that the ICT sector is high on the government agenda, which is followed by the development of strategic documents for guiding its further progress, government measures need to be streamlined more concretely. The existing regulation needs vigorous enforcement, which, in turn, should increase attractiveness of participating in formal networks and clusters for the ICT firms. Also, certain changes in the regulation should be put in place. Tax regulation can be modified to allow for better facilitation of the development of smaller firms and start-ups. To create an image of a "partner", the government could enhance its capacity to provide hands-on support through agencies which would be able to serve ICT businesses as one-stop shops. Such collaborative approach could serve as a facilitating mechanism for promoting the industry on the international stage by endorsing the build-up of the national ICT industry brand through extensive marketing efforts of all stakeholders.

A collaborative approach involving industry stakeholders would also positively affect innovation potential. Although inventors do not file significant number of PCT patent applications, higher patent propensity in the ICT sector in comparison to other sectors demonstrate that innovation efforts are more likely to arise in the ICT domain. Enhanced R&D collaboration should positively affect this dimension. However, opportunities for collaboration between the ICT industry stakeholders are not adequately utilised. The obvious need for collaboration is demonstrated by the human capital issues, as lack of experts with high experience in certain areas. Once the ICT firms move beyond customer-centred outsourcing they will face more common needs in the future such as needs for employing more senior developers and marketing staff. At that point, local networks should already be in place.

With the support of the measures suggested here, the ICT industry in Serbia would have solidified base for further development within the country's economy, as well as, more importantly, at the international stage, effectively contributing to the competitiveness of the ICT sector of Europe. Its growth would exercise greater spillover effect for facilitating

development of bordering industries, increasing country's prospects for economic growth.

References

- Bartlett, C. and Ghoshal, S. (1990), 'Managing Innovation in the Transnational Corporation', in: Bartlett, C., Doz, Y. and Hedlund G. (eds), *Managing the Global Firm*, London, Routledge.
- Boschma. R.A. (2005), 'Proximity and innovation: a critical assessment', *Regional Studies* 39: pp. 61-74.
- Central European Financial Observer (2018), *ICT exports drive Serbian economic growth* [Online]. Available at: <https://financialobserver.eu/cse-and-cis/ict-exports-drive-serbian-economic-growth/>.
- Chaminade, C. and Vang, J. (2008), 'Globalisation of knowledge production and regional innovation policy: Supporting specialized hubs in the Bangalore software industry', *Research Policy* 37, pp. 1684-1696.
- Domazet, I. and Lazic, M. (2017), 'Information and Communication Technologies as a Driver of the Digital Economy', *22th International Scientific Conference, Strategic Management and Decision Support Systems in Strategic Management*, May 19, 2017, Subotica, Serbia.
- Digital Knights (2018), *Dissecting Serbia: Why the nation's IT and Outsourcing is so important, and so good* [Online]. Available at: <https://digitalknights.co/dissecting-serbia-nations-outsourcing-important-good/>.
- Dunning, J. (1994), 'Multinational Enterprises and the Globalization of Innovatory Capacity', *Research Policy* 23 (1): 67-88.
- EF Education First (2018), *EF English Proficiency Index 2018* [Online]. Available at <https://www.ef.edu/eji/>.
- European Commission (2018), *Supporting an Innovation Agenda for the Western Balkans: Tools and Methodologies*. Luxembourg: Publication Office of the European Union.
- Government of the Republic of Serbia (2017), *Plan prioritetnih ciljeva i aktivnosti svih organa državne uprave i službi Vlade za unapređenje IT sektora u Srbiji za 2018. godinu* [Online]. Available at: <http://www.srbija.gov.rs/vesti/specijal.php?id=315878> [Retrieved on 1/10/2018]
- Hackerearth (2017), *Best countries for software engineers and developers to work* [Online]. Available at: <https://www.hackerearth.com/blog/competitive-programming/best-countries-software-engineers-developers-work-2017/>. [Retrieved on 1/10/2018]
- Katic, A., Milosev, I. and Raletic, S. (2013), 'ICT Sector in Vojvodina (Serbia) as a Potential for Mitigation of Crisis Effects', *Procedia - Social and Behavioral Sciences* 75 (3), pp. 298-307.
- Kutlaca, D., Zivkovic, L., Strbac, D., Semencenko, D. and Popovic-Pantic, S. (2018), *ICT Case Study in Serbia: Report on the innovation potential of the software industry in Serbia*, Institut Mihajlo Pupin, Science and Technology Policy Research Centre, Belgrade.
- Nepelski, D. and De Prato, G. (2017), 'The structure and evolution of ICT global innovation network', *Industry and Innovation* 25 (10), pp. 940-965.
- Serbia Business (2018), *IT Sector*. Available at: <https://serbia-business.eu/it-sector/>.
- Team Finland Market Opportunities (2018), *IT Sector in Serbia* [Online]. Available at: <https://www.marketopportunities.fi/it-sector-in-serbia>.

Vojvodina ICT Cluster (2015), *ICT in Serbia at a Glance* [Online]. Available at: <https://vojvodinaictcluster.org/wp-content/uploads/2014/08/ICT-in-Serbia-At-a-Glance-2015.pdf>. [Retrieved on 1/10/2018]

World Economic Forum (2018), *Networked Readiness Index* [Online]. Available at: <http://reports.weforum.org/global-information-technology-report-2016/networked-readiness-index/>.

WBC-RTI (2018), *ICT Research and Innovation* [Online]. Available at: <https://wbc-rti.info/theme/34>. [Retrieved on 1/10/2018]

List of abbreviations and definitions

BoP Balance of payments

CAGR Compound annual growth rate

EU European Union

FP7 7th Framework Programme for Research and Technological Development

GDP Gross domestic product

ICT Information and communication technology

IT Information technology

MNC Multinational corporation

PCT Patent Cooperation Treaty

R&D Research and development

List of boxes

Box 1. Cross-cutting dimension of the ICT sector: BioSense Institute.....	10
--	----

List of figures

Figure 1. World Economic Forum's 2016 Global Information Technology Report.....	7
Figure 2. Total turnover of software sector per selected countries from 2011-2015 (in million EUR, per million inhabitants).....	8
Figure 3. ICT service exports (% of service exports, BoP), Serbia vs selected EU countries, 2008-2017	9
Figure 4. Total number of employees in the software sector in Serbia, 2010-2015	11
Figure 5. ICT PCT patent applications in 2016, Serbia vs. surrounding countries	13

List of tables

Table 1. Export of ICT goods and services of the Western Balkan economies.....	8
Table 2. Number of employees in group 62.0 Computer programming, consultancy and related activities	11
Table 3. Overview of the SWOT analysis of the potential of the Serbian ICT industry	14

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),
- at the following standard number: +32 22999696, or
- by electronic mail via: https://europa.eu/european-union/contact_en

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications

You can download or order free and priced EU publications from EU Bookshop at: <https://publications.europa.eu/en/publications>. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.



EU Science Hub

ec.europa.eu/jrc



@EU_ScienceHub



EU Science Hub - Joint Research Centre



Joint Research Centre



EU Science Hub



Publications Office

doi:10.2760/994464
ISBN 978-92-79-98369-6