



ICT IN SERBIA

AT A GLANCE
2022



www.vojvodinaictcluster.org

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FOREWORD

Milan Šolaja, CEO
Vojvodina ICT Cluster



Hello, world!

We proudly present the sixth edition of this Study, the result of combined efforts of stakeholders from business, research, innovation, education, and public sector included in this project and coordinated by Vojvodina ICT Cluster. Two years after the last edition, we are still on the same path of pursuing our vision Digital Serbia, but with a lot to show for. You will find data in this document that backs up claims that Serbian ICT is advancing with giant steps, becoming the country's number one exporting sector, and

contributing ever more to the national GDP, while tech entrepreneurship is on the rise and with some notable investments in tech ideas and startups made in Serbia.

If you are our regular reader, you will remember that last time we talked about analogue vs. digital, or rather how these domains are compatible.² We urged for stronger uptake of the tech toward increase in competitiveness, quality of life and public service. Little did we know how incoming global pandemic would have changed things for the tech sector.

¹ You can revisit [ICT in Serbia – At a Glance, 2020 edition](#) for more on analogue vs. digital.

Lockdowns and other pandemic-related restrictions disrupted business globally, while numbers of the infected skyrocketed. After the initial shock, it turned out that the tech can help in many aspects of dealing with imposed limitations. Indeed, many studies describe this unexpected boost that pandemic provided to ICT.

Back in Serbia, explosion of e-commerce was just one of many examples. All of a sudden, investments in ICT per capita started to grow and we are finally on the course to reach domestic ICT market value of €1 billion, maybe even more. As we maintained before, reaching the figure of €150 IT investments per capita will put Serbia on track in our pursuit to join developed countries.

Of course, all the pandemic-boosted positive ICT development quickly fades away in the face of suffering of millions throughout the world.

An increased usage of tech products and solutions in Serbia came at the time when interest of new generations for careers in ICT has already been growing steadily.

Nowadays, 20% of all freshmen in Serbia are enrolled in ICT or related studies. However, that is not enough to quench constant thirst of the labor market for new talents.

The political situation in Europe has recently become unstable and worrying. It is too early to assess its effects on the ICT sector in Serbia, we have to wait and see what the future brings. Nonetheless, we hope you will read our next edition in a calmer and more secure world.

For now, dive into the pages of this document and find whatever it is you want to find out about ICT in Serbia. And if you do not find it – drop us a line, we will try to help!

Milan Šolaja, CEO
Vojvodina ICT Cluster

VOICT: PASSION FOR EXCELLENCE



Vojvodina ICT Cluster – VOICT provides a single point of contact with the best companies in Serbia, with the total workforce of 8,000+ experienced IT professionals employed by our members. We build long-term relationships based on trust and quality, bringing expertise, experience, and passion for excellence to each and every project.

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

as a whole. The member companies made a noticeable breakthrough on world markets, putting Serbia on the map as a very interesting alternative location for the development of sophisticated solutions. Vojvodina ICT Cluster gives institutional support to this trend, while the

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

FACTS & FIGURES	
40+ members	8,000+ employees
€24 million worth of EU, bilateral and national projects	
2,200+ students of the Cluster Academy, including 500+ kids learning to code, 350+ people re-trained to start IT careers and hundreds of trainees in Scrum, software testing, and soft skills.	

strong support from the University of Novi Sad adds to the strength of the cluster.

The cluster has its own Academy, organizing trainings, presentations, and lectures according to the needs of the

members and wider ICT community, as well as a separate Project Office that grows its projects portfolio and revenue every year, making Vojvodina ICT Cluster a leader in excellence among organizations of this type in Serbia.

GIZ – AN INNOVATIVE PARTNER FOR THE GLOBAL CHALLENGES OF TOMORROW



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As a service provider in the field of international cooperation for sustainable development and international educational work, we are dedicated to shaping a future worth living across the world. GIZ has over 50 years of experience in a wide variety of areas, including economic development and employment promotion, energy and the environment, and peace and security. The diverse expertise of our federal enterprise is in demand around the globe – from

the German Government, European Union institutions, the United Nations, the private sector, and governments of other countries. We work with businesses, civil society actors and research institutions, fostering successful interaction between development policy and other policy fields and areas of activity. Our main commissioning party is the German Federal Ministry for Economic Cooperation and Development (BMZ).

We work with businesses, civil society actors and research institutions, fostering successful interaction between development policy and other policy fields and areas of activity.

The commissioning parties and cooperation partners all place their trust in GIZ, and we work with them to generate ideas for political, social and economic change, to develop these into concrete plans and to implement them. Since we are a public-benefit federal enterprise, German and European values are central to our work. Together with our partners in national governments worldwide and cooperation partners from the worlds of business, research, and civil society, we work flexibly to deliver effective solutions that offer people better prospects and sustainably improve their living conditions.

Facts and figures

GIZ operates throughout Germany and in more than 120 countries worldwide. Our registered offices are in Bonn and Eschborn. We have 20,726 employees around the

globe, almost 70 per cent of whom are employed locally as national personnel*. In 2017, we generated a business volume of around €3 billion.

*Personnel figures as of 31 December 2018

For further information on GIZ, please visit www.giz.de

Private sector development in disadvantaged regions of Serbia – PSD

Project term: 2017 to 2022

The PSD project promotes competitiveness of micro, small and medium-sized enterprises (MSMEs) in Serbia. PSD works in different fields with the purpose of strengthening the public and private service providers (mainly the Chamber of Commerce and Industry of Serbia — CCIS), MSMEs and the relevant line ministries.

In order to reach the objective, the project is active in four areas of intervention:

1. Improvement of the service offer of private and public actors in order to support MSMEs.
 2. Service offer support for MSMEs in selected value chains (VC): IT, metal and mechanical engineering, sustainable agriculture, and tourism.
 3. Contribution to the national industrial policy, focusing on the advisory of the Serbian Ministry of Economy and the involvement of the private sector needs mainly in the selected VC of the project.
 4. Promotion of Tourism in the Lower Danube Region for development of a competitive tourism offer in this region – through co-financing with the EU.
- Development of new startup business models.
 - Strengthening of women entrepreneurship.
 - Incorporation of private sector needs (mainly MSMEs in the selected VCs) into public acting through co-financing with the EU.
 - Increased capacities of Ministry of Trade, Tourism and Telecommunications and other stakeholders as part of the Tourism Development Strategy of Serbia implementation and Lower Danube region tourism development.
 - Enhanced competitiveness of tourism offers and infrastructure in Lower Danube region.
 - Upgraded facilities of selected tourist sites in Lower Danube region and Belgrade.
 - Enhanced visibility of Lower Danube region on domestic and international markets.

Expected impact

- Enlargement of the MSME service offer in private sector organizations resulting in business growth.
- Enhancement of B2B relations in the selected VCs.
- Increase of MSME productivity through the implementation of new ICT solutions.
- Enrichment of entrepreneurship through start up promotion in selected Serbian regions.

Data source partner

(Data provider)



www.sito.rs

SUMMARY OF IT STATISTICS

Domestic IT investments

We estimate that in 2021 IT market reached €736 million, an annual growth of 9%. Considering all the complex circumstances and global pandemic, maintaining any growth can be seen as an extremely positive phenomenon. Lest we forget, for four years in a row (2017-2020) domestic IT market records permanent growth at the rate slightly higher than 10% and is currently at its historic maximum. If we talk in terms of IT investments per capita, Serbia has finally crossed the psychological barrier of €100 per capita. This is a small, yet very important step in the country's future development.

IT services make a difference

The domestic market of IT services has come close to the value of €300 million and is growing at an annual rate just over 10%. On the other hand, IT export amounts to €1.7 billion and recorded the growth of 30% in 2021. For a better picture about Serbia, IT export is not enough, we need to additionally increase domestic investments.

Serbia participates in global IT exports with .3% and there is plenty of room for further growth. However, to achieve that growth we need IT experts that we currently lack. For example, to achieve IT exports of €3 billion in 2023.

according to the current business models of prevalent outsourcing, additional 10,000 IT experts are needed. If the shift would happen toward export of domestically developed software solutions for global markets, we would lack 5 to 6 thousand.

Sectorial analysis

The growth of domestic IT industry is continuing. In 2021, 3,768 companies were active, employing 48,173 people. The pillar of IT industry are small and medium-sized enterprises (SMEs). Although SMEs make just over a fifth of the total number of IT companies, by income, employees, capital, and revenue, they make two-thirds of the entire business activity of IT sector in Serbia. The majority are software development companies (2,652) and make 70% of the total number.

Government's activities in ICT

ICT is a dynamic field and requires that government continually works on advancement of regulatory

framework and infrastructure. According to the European Commission Progress Report for Serbia in 2021, in the Chapter 10 – *Digital Society, Council for Development of Digital Economy, Innovation, Hi-Tech Entrepreneurship and Digitalization of Businesses* was established. Action plans for implementation of Smart Specialization Strategy of Serbia 2020-2027, as well as for Industrial Policy Strategy 2021-2030, aiming to improve digital skills and increase competitiveness of Serbian industry and advance business models digitalization. Also, attention is increased to overcoming the digital divide for elderly and marginalized population groups.

Network Readiness Index 2021

In its latest version for 2021, NRI report gives international comparison of 130 economies, based on 60 individual parameters grouped in four different pillars: technology, people, management, and influence. Total rank for Serbia is 57, which is 5 places worse than in 2020. Despite this fall in ranking, Serbia has increased the value of its NRI index from 52.96 to 53.60, which was not enough to keep the

position on the list. Apparently, other countries grew faster and overtook Serbia.

Instead Forecast

What can we expect up to 2025? This is a “million-dollar question”. There’s no reliable long-term forecast, we can see only a quarter in advance. In current unfavorable circumstances we can only wish for all key IT indicators in Serbia to keep double-figure trend of annual growth. Lest we forget trends from the last five years: IT market growing by 10%, IT services export by over 25% and IT employment by more than 15% each year.

Many believe that even the looming global political and economic crisis is somehow good for IT business. Strong technology transition is unfolding, and all big economies see new technologies as a way out, while all bit IT players invest heavily in technological development.

Is it wise to cut the risks and park IT business in a safe harbor – or move boldly on? It will all depend on individual decision-makers, as historically was always the case. We believe that numbers and the analysis that follow below can help many decision-makers in these exciting times.

1

GENERAL BUSINESS ENVIRONMENT

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

General Statistics, 2021

ICT Statistics*

- Percent of GDP spent on R&D: less than 1.0% (government fund estimated at 0.5%)
- IT market: €736 million (IT service 39.7%, software 16.5%, hardware 43.9%)
- IT investments per capita: €108 (1.4% of GDP per capita)
- Total IT industry revenue in EUR: €3.93 billion (7.4% of GDP)
- IT services export: €1.7 billion (3.2% of GDP)
- Telecommunication sector revenues: €1.99 billion (3.7% of GDP)

- 3,768 IT companies with 48,173 employees (2.4% of total Serbian workforce)
- Revenue per employee in IT: €81,591

** Data for 2021*

- Population (millions): 6.9
- Capital: Belgrade
- Territory area: 88,499 km²
- GDP (€billions): 53.2 (per capita: €7,71)
- GDP per capita (in purchasing power standards (PPS)): €15,700
- GDP per capita (in PPS), relative to the EU average (EU28 = 100): 43
- GDP (PPP) as share (%) of world total: 0.09

- 76.7% of households have personal computers
- 77.6% of households have fixed broadband Internet access
- 94.6% of households have mobile phones
- 120 Mobile telephone subscriptions/100 pop
- 34.8 Fixed telephone lines/100 pop; 99.9% digitized network
- Percent of GDP spent on R&D: less than 1.0% (government fund estimated on 0.4%)
- Public expenditure on education relative to GDP (%): 3.6

ICT Statistics

1.1. CURRENT BUSINESS CLIMATE IN SERBIA

Two steps forward – one step back

The Serbian economy recorded only a mild contraction (-1.1%) in 2020 as the impact of the COVID-19 crisis was mitigated by a strong pre-crisis momentum, sizeable and timely fiscal and monetary support measures, the sectoral structure of the economy and a relatively low average stringency of containment measures. Serbia's GDP growth was a healthy 7.0% in 2021, which was in line with the wishes of the Government and the targeted GDP growth of 4-5% for this year.

In December 2021, Serbia reached BB+ credit rating, the highest level in the last 10 years. One more step is needed to reach the investment level. In general, credit rating is used by sovereign wealth funds, pension funds and other investors to gauge the credit worthiness, thus having significant impact on countries' borrowing costs.

Public investment has continued to increase with the aim to address serious infrastructure gaps after years of underinvestment. Although the cost of borrowing for small and medium-sized enterprises (SMEs) has declined, they still face a number of challenges, including a volatile business environment and unfair competition. The state retains a strong footprint in the economy and the private sector is hampered by weaknesses in the rule of law, in particular corruption and judicial inefficiency.

Serbia trapped in transition?

Since the 2000s, Serbia is in a slow, post-socialist transition. This period is characterized by insufficient changes toward accession to the EU before 2025. The reason is clear, the

root is deep and consequences of blocked transformation in the period 1990-2000 are felt even today. There is much to do in changing the role of government, pervasive social values and building EU-like capitalism.

The Stabilization and Association Agreement (SAA) between Serbia and the EU entered into force in September 2013. Serbia continued to implement the SAA, although several compliance issues remain. Serbia accepted the revised enlargement methodology, and a first political inter-governmental conference was held in June 2021. The overall pace of negotiations will continue to depend on the pace of the rule of law reforms and on the normalization of Serbia's relations with Kosovo².

Continual annual GDP growth of more than 5% until 2030 is necessary for full economic recovery. To accomplish that, Serbia needs to modernize its economy. Therefore, Serbia faces double transformation today: apart from closing post-socialist

(ANALOGUE) transformation of economy and society, this country needs to start technological (DIGITAL) transformation via smart and strategic investments across sectors.

Relying only on DIGITAL (technology) will not get our society out of trouble. Investments in digitalization is important, but insufficient condition, for kick-starting Serbian economy — it is necessary to strengthen ANALOGUE Serbia (institutions) and eliminate systemic obstacles.

1.2. GENERAL IT TRENDS, DRIVERS AND BARRIERS

IT market overview

IT spending in Serbia grew steadily in 2021 compared to the previous year. The growth of the IT market so far can be attributed to the strengthening of the economy, increased public procurement and government tenders and certainly

* This designation is without prejudice to positions on status and is in line with UN Security Council resolution 1244 and the International Court of Justice Opinion on the Kosovo declaration of independence

² According to the European Commission STAFF WORKING DOCUMENT, Serbia 2021 Report, Brussels, 19 October 2021.

the growth of prices of domestic IT providers, which were often below 50% level of prices achieved in Western Europe for the same expertise.

Serbian IT market grew 9% year-on-year in 2021 to €736 million. Total IT spending is projected to exceed €950 million by 2025, based on a four-year CAGR of 7%. Like other developing markets in the CEE region, the Serbian IT market continues to move towards software and services.

Drivers

- **GDP growth** projected up to 3.5% in 2022 (Source: World Bank). According to the IMF, GDP in Serbia should rise at a rate of 4% to 6% throughout the 2023-2025 period. The IT market typically grows 2-3 times faster than GDP.
- **EU accession:** If Serbia steps up efforts to achieve EU standards and EU accession, it should benefit from greater foreign direct investment, **provided a proper FDI Strategy was in place.** The country will need to undertake significant political and economic reforms, which need to improve the overall business climate and attract investors.

Inhibitors

- **Strong negative prospects** for the Serbian economy are possible in 2022. The war in Ukraine resulted in a European political crisis with possible further escalation. The EU economy is on the brink of recession. Weak economic growth within the EU is generally hampering Serbia's economy and investments, which could result in a weakening of the domestic IT market.
- Both corporate and home user segments lack the resources to invest in IT. **The at-risk-of-poverty or social exclusion rate (AROPE)** is very high (29.8%) and down 1.9 percentage points from the previous year. The risk of poverty or social exclusion corresponds to the total number of persons who are either at risk of poverty, or severely materially deprived or living in a household with very low work intensity. **Weak industry:** Although the industrial sector in Serbia has expanded in the last few years, in 2021 its total output was less than 65% of the level achieved in 1989.
- **Fragile political situation:** Still unresolved situation of the province of Kosovo threatens Serbia's future political development. Political relations with neighboring

Table 1. Key parameters for the Serbian IT market forecast, in Q2-2022

ECONOMIC FACTORS	Factor power	Factor value (Intensity)			
GDP growth projected up to 3,5% in 2022 (Source: World Bank)	3	25			
Insufficient investment. The flow of foreign direct investment slowdown	2	25			
Exchange rate. The US dollar has strengthened significantly against the euro and is currently at its highest level in 20 years.	2	25			
Potential of IT modernization – need for IT investment (yearly growth of at least 10% until 2025)	1	25	50		
Consumers					
In case of a stronger economic crisis, diminished profit growth could postpone important IT projects.	2				
Government institutions could, in complex business conditions, delay large IT procurements.	2				
IT replacement cycle. Only by maintaining existing IT infrastructure can guarantee annual IT investments of over €500 million annually.	1	25			
IT market					
Tech transition is under way. Average prices of equipment and services are growing. Sales margins too.	3	25	50		
Pandemic caused crisis in supply channels and IT equipment supply is slowed.	2	25	50		
Export-oriented software companies impose fierce competition in the labor market. An insufficient number of IT talents influences business of companies working for the domestic market.	2	25			
Financing options for IT investments must be much better.	1	25			

Source: SITO, 2022**Legend:** Factor Power 3 – very strong factor; 2 – strong factor; 1 – moderate factor

Examples for Factor Value:



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



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

countries: Croatia, BiH and Montenegro should be raised to a much higher level. Serbia's foreign policy is partially in line with the EU, which it aspires to join.

- Despite solid progress, the quality and relevance of education and training do not fully meet labor market needs. IT talents are needed both in Serbia and globally. Employment of IT experts for the needs of the domestic market so far was in the background, as the first priority was with the IT services export companies. To make matters even less favorable, we have a trend of outsourcing that prevails over Serbian made software in the total IT export from Serbia. This could slow domestic digital development, while investments made in education of IT experts turns into a non-refundable loan to foreign IT companies and other global markets.

1.3. WHERE DOES SERBIA STAND ON THE EU TECHNOLOGICAL MAP?

On the global technology map, Serbia continues to be somewhere in the middle. As stated in our last report, we really need to take care of the wider picture. The situation in which 20% of countries continue to make up 80% of total investments in the new technologies, means that the gap

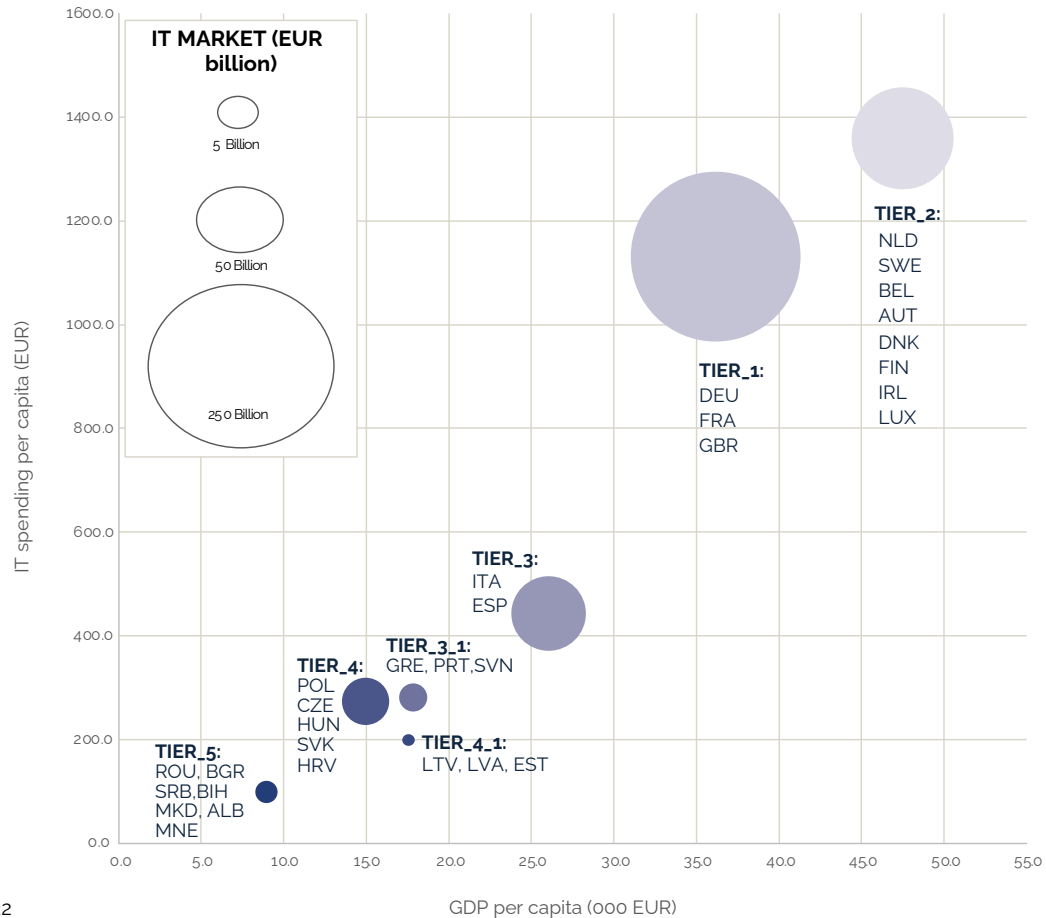
created by global information capitalism is nowhere near closing. Consequently, challenges of further increase of digital divide are still here for smaller countries, Serbia included. The governments of these countries still need to lay the foundations for stronger development and a chance to decrease lagging as much as possible.

Logically, Serbia stands better on the global technological map than on the European one. Economic competitiveness as well as the society organization and transparency are best illustrated with the diagram of IT investment per capita according to economic strength (GDP). Huge differences are clearly visible among the European countries in IT investments per capita (Y-axis), GDP per capita (X-axis) and the size of the total IT market (circle size). After the analysis, 5 basic groups were formed (Tier levels) and in each of them are countries with similar perspective, comparable by similar prospects for future technological development strategies.

Key observations:

- **Tier 1** (21% total IT market of EU) includes seven Western European countries, the leaders in IT spending per capita (€1,350) and in GDP per capita (more than €45,000). With

Figure 1. *IT investment according to economic strength (GDP).*



Source: Model by SITO, 2022

populations between 5 and 15 million, all these countries have both critical mass and flexibility to strategically focus on the most important trends in global technological development.

- **Tier 2** comprises gigantic IT markets (DEU, FRA, GBR) with values of almost €250 billion in total which is 60% total IT market of EU. Each country in this group has enormous capacity, which is their main argument – economies with large capacities most often win in the market competition.
- **Tier 3** gathers sub-Mediterranean countries, which can be observed through two sub-groups: (1) comprises Italy and Spain, with large potential for IT market growth and for strong technological advancements. Both countries have large populations and economies and fall into the top five EU members, while (2) comprises Greece, Slovenia, and Portugal, that have smaller base, moderate capacity, and no high IT priority for now.
- **Tier 4** also has two clusters – one with Central Europe countries having solid industrial tradition, but big risk of technological lag and innovations that are weaker than in countries from the previous three tier groups. With similar performance, three smaller Baltic states are grouped in

the second cluster. These countries have a lot in common and provide very good basis for implementation of joint strategic orientations.

- **Tier 5** is the last European wagon with seven countries of the Adriatic and Black Sea regions. Serbia falls into this group characterized with weak economies (less than €10,000 GDP per capita), small capacities and very low levels of IT investments (around €100 per capita). Weak performance of these countries should be mitigated through a strong support of special programs of financial assistance and actions from the EU level – to catch-up with the European processes of technology development. Geographical and cultural proximity of these countries can significantly facilitate implementation of joint actions and strategic plans.

Serbia will remain in the global digital divide until total IT investment stagnates below 2% of GDP. Serbian society and economy have a chance to connect on the path of accelerated recovery if IT investments reach 3% of GDP until 2025. Translated to the level of IT investment per capita, the same goal becomes more challenging: Current investment of €100 per capita should be increased to

€150. **Therefore, to narrow the digital gap, Serbia needs an average annual growth rate of the IT market more than 10% until 2025.**

1.4. NETWORK READINESS INDEX OF SERBIA

The Network Readiness Index (NRI³) is one of the leading global indices on the application and impact of information and communication technology (ICT) in economies around the world. In its latest version of 2021, the NRI Report maps the network-based readiness landscape of 130 economies based on their performances in four different pillars: Technology, People, Governance, and Impact. Each of these pillars is itself comprised of three sub-pillars (see Figure below) that have been populated by a total of 60 variables.

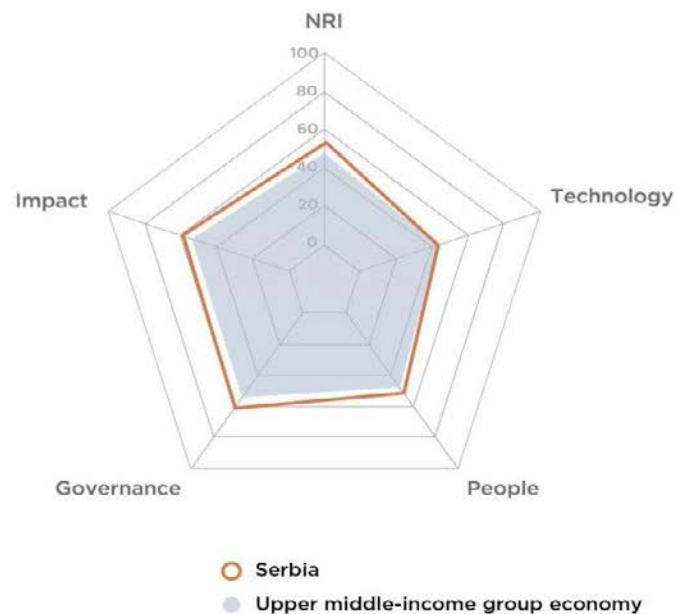
In general, Serbia ranked 57 this year, which is 5 positions worse than in 2020. Despite this fall in ranking, Serbia has

increased the value of its NRI index from 52.96 to 53.60 – which was not enough to keep higher position. Apparently, other countries grew faster and overtook Serbia. This may not be so much worrying result, but it is a warning to the policy creators that domestic application of IT must be stronger. We remind that the domestic IT market has been growing annually by just over 10% in recent years, while IT services export grows by 30% annually on an average. Certainly, a better picture of Serbia requires more than reliance on software export.

³ Initially launched in 2002 with the World Economic Forum, the NRI has been redesigned in 2019 by its founders and co-editors, now under the auspices of the Portulans Institute. The 2021 NRI is the third edition of this renewed methodological model, and it is focused on the impact of digital technologies on making the post-COVID world more equal.

Table 2. *Network Readiness Index 2021. Serbia Profiles*


Network Readiness Index		
	Rank (out of 130)	Score
Pillar/sub-pillar	Rank	Score
A. Technology pillar	71	42.68
1st sub-pillar: Access	70	64.13
2nd sub-pillar: Content	44	44.88
3rd sub-pillar: Future Technologies	112	19.05
B. People pillar	56	51.35
1st sub-pillar: Individuals	65	62.71
2nd sub-pillar: Businesses	57	43.57
3rd sub-pillar: Governments	49	47.77
C. Governance pillar	50	61.64
1st sub-pillar: Trust	51	51.62
2nd sub-pillar: Regulation	54	66.89
3rd sub-pillar: Inclusion	56	66.42
D. Impact pillar	50	58.73
1st sub-pillar: Economy	52	43.00
2nd sub-pillar: Quality of Life	56	71.51
3rd sub-pillar: SDG Contribution	67	61.69



Source: <https://networkreadinessindex.org/country/serbia/>

Strongest and weakest NRI indicators

The indicators where Serbia performs particularly well include: (1) ICT regulatory environment, (2) ICT services exports, and (3) adult literacy rate (Table below). By contrast, the economy's weakest indicators include: (1) affordable and clean energy, (2) computer software spending, and (3) e-commerce regulatory framework.

What is the importance of the NRI analysis? Well, NRI results are getting better and better in reflecting the state of affairs in Serbia. There is no drastic difference between quantitative and qualitative factors – as it used to be in previous years.

Table 3. Strongest and weakest indicators of Serbia, 2021

Strongest indicators	Rank	Weakest indicators	Rank
3.2.2 ICT regulatory environment	11	1.3.3 Robot density	51
4.1.6 ICT services exports	11	3.3.4 Gender gap in Internet use	74
2.1.5 Adult literacy rate	20	3.2.4 E-commerce legislation	76
2.2.1 Firms with website	20	1.3.4 Computer software spending	101
3.2.5 Privacy protection by law content	29	4.3.4 SDG 7: Affordable and clean energy	103
2.3.4 R&D expenditure by governments and higher education	32		
4.3.5 SDG 11: Sustainable cities and communities	34		

Global analyses of this type (WEF and similar) are the most widely accepted international ranking and most used in the media in the past decade. Although WEF has no formal authority, ranks of countries are accepted by many economists, policymakers, leaders, and experts from diverse domains. It's fair to say that WEF evaluation creates a perception that strongly affects reality. Because of that, a careful analysis and use of developed tool from *The Network Readiness Index* framework is recommended.

It would be of great importance for Serbia to introduce additional indicators to better identify its national goals. The introduction of new statistical indicators would ensure a more accurate overview of the current situation and especially identification of faults. As a roadmap, **actions in strengthening human capital should be elaborated**. In terms of the current workforce, we need to increase the availability of scientists and engineers and raise digital skills among the population. Considering the future of human

capital – attracting and retaining talents should be in focus, together with the importance of on-the-job training.

Some of the guidelines for the **technology platform** are to harmonize FDI with technological transfer; increase firm-level technology absorption. In terms of **innovation capability**: to stimulate enterprise investment in new technologies and companies that embrace disruptive ideas.

In terms of NRI and given that the future is uncertain and hard to predict, the framework and methodology will continue to be updated as the future unfolds. Furthermore, engagement activities, such as multi-stakeholder workshops and country as well as regional in-depth analyses, will be conducted in select countries to catalyze multi-stakeholder dialogue and action and complement quantitative findings with qualitative insights.

2

ASSESSMENT OF THE SERBIAN ICT SECTOR

This chapter aims to show the state of Serbian IT through three components: (1) IT market; (2) buyer analysis according to IT investments, and (3) sectoral analysis of IT industry.

These three angles of view give a compact and comprehensive picture of the Serbian IT scene, which points to the level of technical and technology levels and trends in future development. Twelve different detailed analyses of the Serbian IT scene, which SITO conducted in 2021, are the foundation for compressed data shown in this chapter. Detailed reports guarantee a high level of reliability for data displayed and, at the same time, elaborate specific topics with far more details needed by

experts from different areas, as well as for creators of IT policies – toward a complete understanding of the situation in each individual topic.

2.1. ICT MARKET – A STATISTICAL OVERVIEW

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

- IT Market value and structure
- An overview of the telecommunication market
- When measured according to the revenue per capita, the Serbian ICT market is lagging far more than according to the indicators of IT usage. The main reasons for this are:
- Buyers mostly focus on basic ICT solutions and low-end specifications.
- Buyers' orientation on non-brand solutions is higher than on the A-brand ones.
- Low prices of the ICT solutions are an imperative.
- The cost of local IT services and software is up to 50% lower than the EU average for the same specifications/expertise.
- The replacement cycle is far longer than in EU countries (instead of 3-4 years, ICT solutions are replaced after 6-7 years and even longer).

2.1.1. IT Market Value and Structure

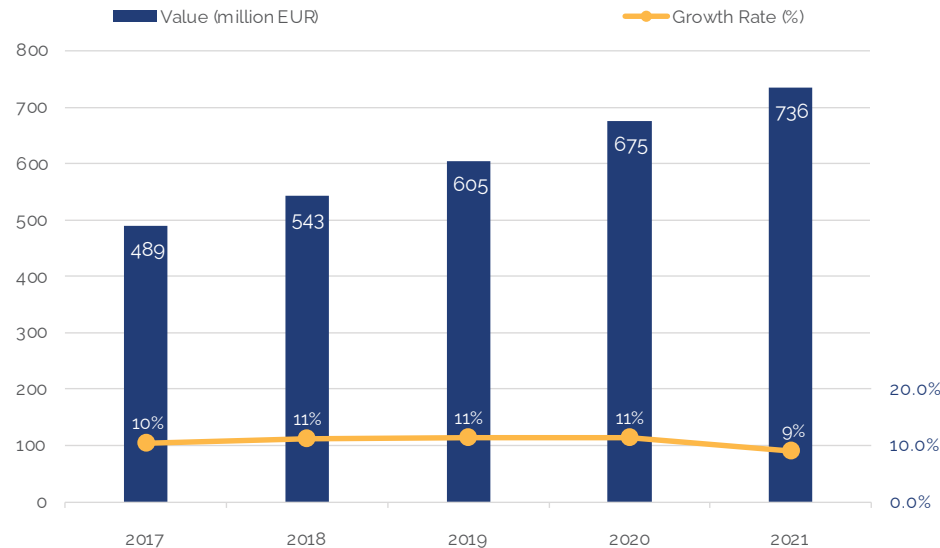
IT market – What's on sale? The Serbian IT market generated €736 million in 2021, which represents an annual growth of 9%. However, the trends of the three main market segments deviate from this average. The largest segment,

IT services continues to grow at a rate of more than 10%. IT service market growth is largely based on supporting existing business infrastructure worth more than €1 billion. Solid market growth in the software segment is estimated at almost 9%. The hardware, equipment and computer shipments segment grew by about 7% annually.

- In the period 2017-2020, IT market recorded double-digit growth four years in a row, and it is on its maximum value right now. Considering unfavorable circumstances, war in Ukraine, global political crisis, looming energy crisis, and health crisis that accompanied us entering 2022 – maintaining any growth of IT market is deemed a very positive development.
- If we look at the market value through the lens of IT investments per capita, Serbia has finally crossed the modest €100 level. That is a small, but an important step, in the further development of Serbia. The CEE countries record IT investments per capita of over €300.

Key observations from the figure above:

- In the 2021 IT market structure, the segment of the IT Hardware with 43.9% share is dominant, followed by IT

Figure 2. *Serbian IT Market and Growth Rates for 2017-2021.*

Source: SITO, 2022

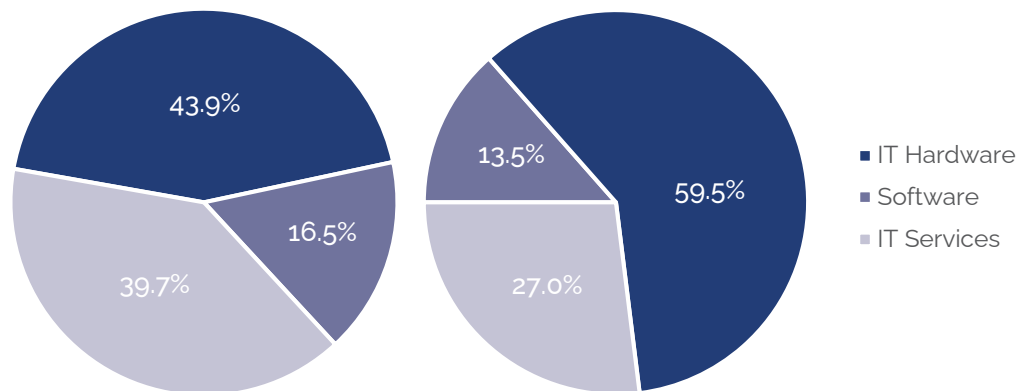
Services segment with 39.7%, and the remaining 16.5% comes from Software. Such a market structure, according to European standards, clearly points to the market that is still not quite mature.

- Although IT Hardware still drives the IT market in Serbia, profit margins of hardware companies are extremely low and consequently so is their profit. The highest available

net profit, more than one half of the total IT industry net profit, is generated by the companies from the Software sector (59.5%).

- The Serbian services and software market will expand at a greater rate than the overall IT market until 2025, thanks to relatively small base. Domestic vendors are strongly advised to consider that without a strategic approach

Figure 3. Serbian IT Market Structure vs. Profit in the IT Sector in 2021.



to development they could face the threat of not being capable to meet the future growth projections.

2.1.2. IT Services Market

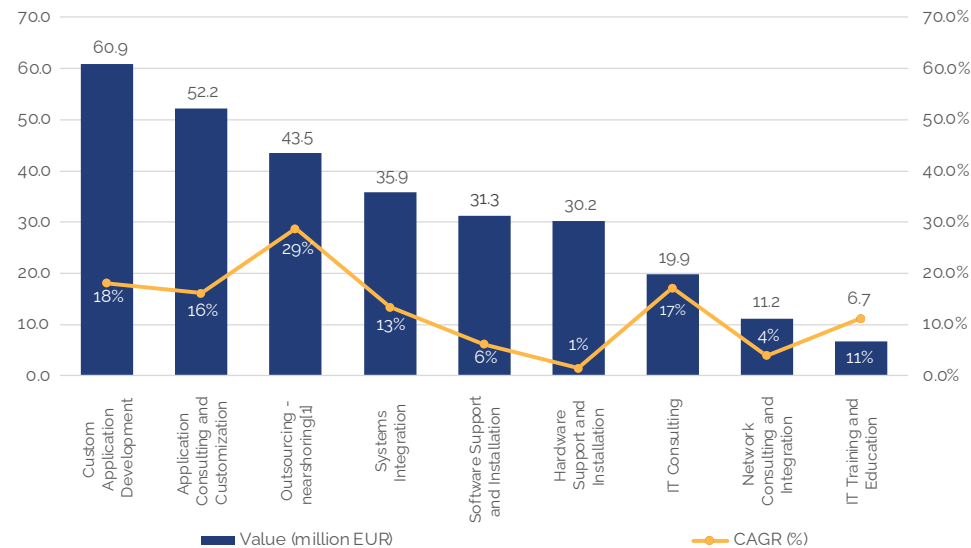
The IT services market achieved the value of €291.8 million in 2021, which is an annual growth of 10.7%. In this phase of the domestic IT services market development, we need double-figure growth every year.

In the period 2016 – 2021, IT services market almost doubled, from €156.3 million to €291.8 million. The average

growth rate was 13.3%. This growth in IT services can be attributed to strengthening of the economy, increased public procurements and government tenders, but also to increase of prices with domestic IT suppliers which often were less than 50% of prices that could be found in Western Europe for the same expertise.

Additional comments on the figure above

- System integrators are the leading sector among IT services suppliers. Global suppliers are also more and

Figure 4. *Structure of IT Service in Serbia in 2021 and CAGRE (5-year period).*

Source: SITO, 2022

more present. Growth of domestic IT services market favors global vendors who take the opportunity to strongly enter Serbian market, as increased volume of business decreases potential conflict of interest of global vendors with their local partners, primarily big system integrators.

- In 2021, 12 companies reached individual revenues from IT services that were larger than €5 million. Their summary revenues from IT services amounted to €108 million, which makes 37% of the market.
- The four major vertical markets: Government, finance, manufacturing, and telecommunications are likely to be

the largest spenders on IT services in Serbia in the coming years. As Serbia continues to stabilize both economically and politically, it has the potential to increase its FDI. As in other developing countries in the region, these four sectors have been the prime beneficiaries of the inflow of FDI, which has fostered spending on IT services.

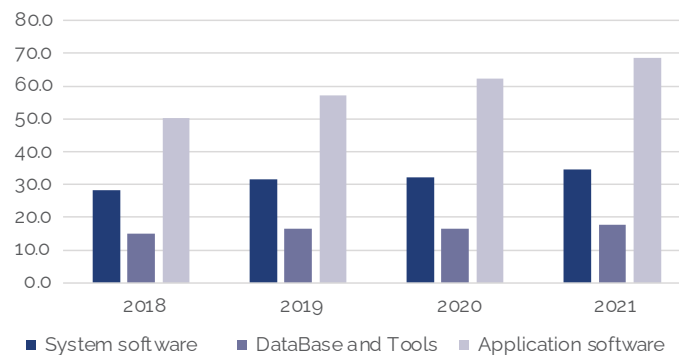
The domestic IT services market approaches the value of €300 million and grows at an annual rate of just above 10%. On the other hand, IT services export has surpassed €1.7 billion, with the annual growth of 30%. For better technological picture of Serbia, reliance on software exports is not enough and increased domestic IT investments are needed.

Companies using IT infrastructure are relying too heavily on their own IT departments, unlike the trend in developed countries, where professional services are being outsourced for IT solutions. A significant part of IT services is internal (end user companies rely on their own IT departments). These services are not included in the analysis.

2.1.3. Application Software Market

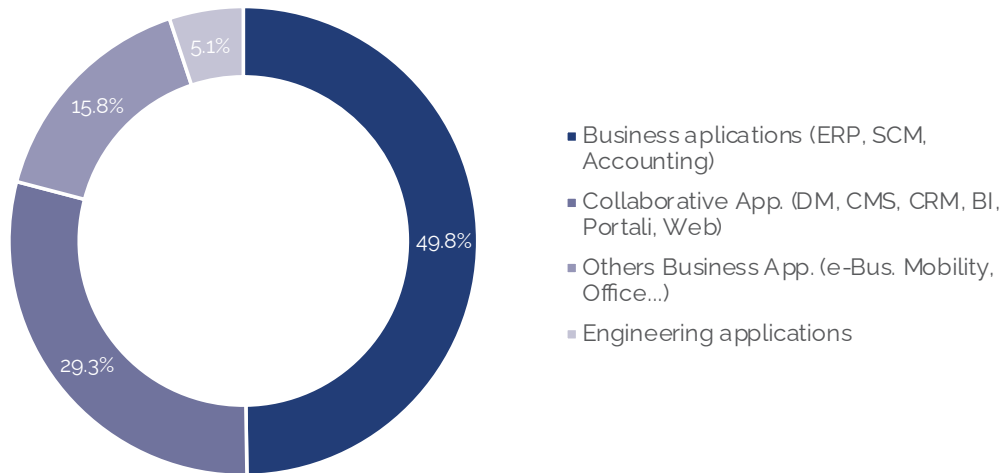
In the period 2016-2021, the application software market rose from €42.2 to €68.6 million. The average annual growth rate in the observed period was 10.2%. This market is expected to continue to grow at an annual rate of more than 10% until 2025, which can be attributed to the Improved business climate and increased government investment in IT. Increasing demand for software applications – both off-the-shelf solutions and custom developed packages – will drive growth in this foundation market in the period 2022-2025.

Figure 5. *Software Market in Serbia 2018-2021*



Source: SITO, 2022

Figure 6. *Structure of Application Software Market in Serbia, 2021*



In 2021, the Serbian market for application software reached a value of €68.6 million. Business applications (ERP, SCM, and Accounting) make up the largest part, constituting 49.8%. Collaborative applications (DM, CMS, CRM, BI, Portal, and Web) follow with 29.3% of the market share.

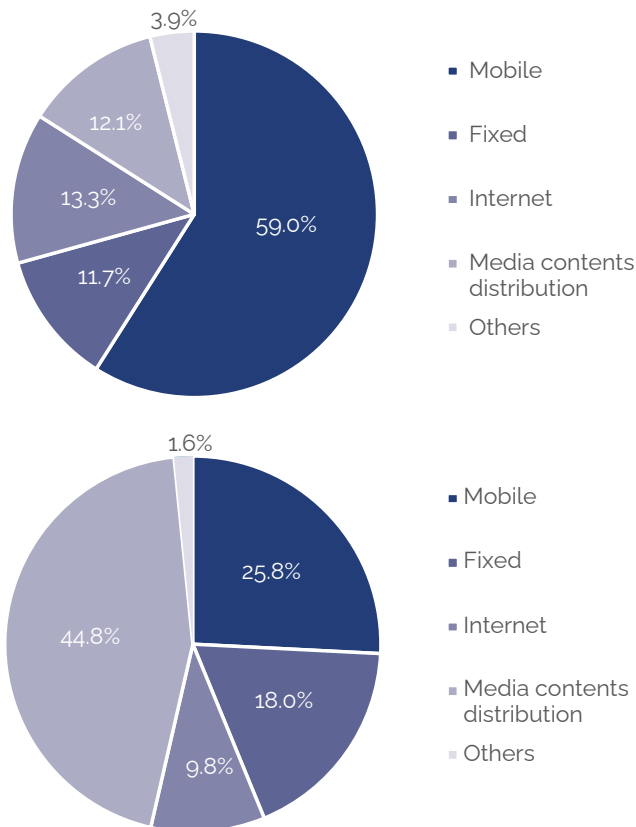
Local software producers dominate the Accounting and ERP market in Serbia, given their flexibility in developing custom software applications. Custom application development

represents an option for a large number of companies (particularly SMEs) seeking a software solution.

2.1.4. An overview of the telecommunication market

According to RATEL's data, the revenues from telecom services in 2020. amounted to €1.8 billion. The average annual growth rate (CAGR) of the telecom sector revenues

Figure 7. Revenue and Investments by Telecommunication Services, in 2020



Source: [National Telecommunication Agency] 2020

in the period from 2015 to 2020 was 1.5%. In terms of different services, in 2020, the largest share in the total revenues, approximately 59% goes to the mobile market, whereas Media content Distribution with 12.1% represents the smallest share.

The total investments in the telecom sector in 2020, amounted to €410.5 million. Accordingly, investments in CATV have the largest share in the total revenues (44.8%), whereas investments in mobile market 25.8%. The structure of telecommunications sector revenues and investments is given below (Figure 7).

The total income earned from providing Internet services reached RSD 28.3 billion (around €240 million) in 2020, which is the growth of 9% compared to 2019. The income was ten times multiplied in comparison to the year 2006 when the data were recorded for the first time.

Internet Operators. A total of 205 Internet operators were registered in Serbia by December 2020, approximately 10% lower than it had been in 2011.

Table 4. *Total Number of Internet Operators in Serbia*

Period	2015	2016	2017	2018	2019	2020
Number of operators	212	214	205	194	210	205

Broadband Internet Penetration: Unless 4G mobile network subscribers are taken into consideration, the penetration of fixed broadband Internet (per 100 citizens) access amounts to 25%, which is above average in the SEE region (20%). However, the penetration of broadband Internet access in Serbia is below the EU27 average (30%). The number of broadband Internet connections per 100 household was approximately 70 in 2020.

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

2.2. IT INVESTMENTS AND INFLUENCE ON OVERALL ECONOMIC DEVELOPMENT

This chapter contains data on IT investments and application of IT in other sectors. The goal of this chapter is to help us see the influence of the IT market on the economy, level of technical and technological preparedness of the economy and the society at large, with a special reference to the situation in the area of e-commerce. Through an analysis of digital vitality and level of digital transformation of public and private enterprises in Serbia, we gain insight into adaptation of organizations to technological change.

2.2.1. Why IT investments particularly?

One of the core potentials for Serbian IT companies remains to be the local market. The Serbian economy is still in transition,

with outdated production lines that should be replaced with new technologies. IT solutions are also necessary for increasing efficiency in management. Investments are always important, especially in a crisis. Since the information technologies are at the base of every optimization, the crisis is the right time for strategic investments.

The main reasons are:

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

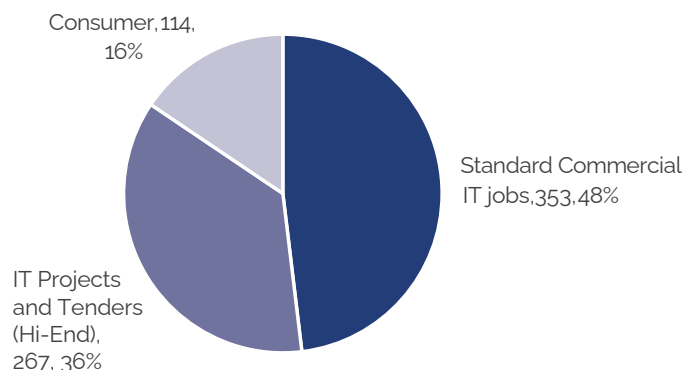
2.2.2. IT investments according to sector and company size

Business users – standard and tender IT investment

The basis for the analysis is made from the total IT market in 2020. For the sake of analysis focus on companies, the data

has been divided on the part of the business users only in standard and project/based (procurement) businesses.

Figure 8. *IT market in 2021 and distribution to businesses and consumers (million €).*



Source: SITO, 2022

- According to the types of buyers, business users (commercial) hold €620 million, which makes 84% of the IT market. The remaining €114 million, or 16%, belongs to private citizens (consumers).
- For this report, the segment of project-based business is very important and is estimated to €267 million, which is 36% of the IT market. The remaining €353 million (48%)

of business part of the IT market belongs to standard businesses (commodity) fragmented to thousands of organizations, predominantly in the SME segment.

Table 5. *IT investments according to buyer's sector in 2021.*

	Value [million €]	Participation [%]
Agriculture and mining	8,5	1,2%
Manufacturing (processing)	84,3	11,5%
Energy, public and utility companies	65,3	8,9%
Construction and construction material	12,5	1,7%
Trade and tourism	58,3	7,9%
Traffic and warehousing	19,5	2,7%
Communication (ICT), broadcasting and media	78,0	10,6%
Finance and services	66,5	9,0%
Business services	28,3	3,8%
Public administration and state-financed activities	190,4	25,9%
Others and household	124,1	16,9%
TOTAL	735,7	100,0%

Buyers by business models

This chapter shows IT investments according to business sector and company size, in 2020. Here is the data about investments in information technology and its application in all sectors. This data is a precondition for further analyses of a) influence on total economic development, and b)

Table 6. *IT investments according to company size in 2021.*

Function	Value [million €]	Share [%]
Large systems (1.000+ employees)	183,2	24,9%
Large enterprises (250-999 employees)	66,3	9,0%
Medium enterprises (50-249 employees)	77,6	10,5%
Small enterprises (10-49 employees)	65,1	8,8%
Micro enterprises (<10 employees)	38,7	5,3%
Public administration and state-financed organizations	190,4	25,9%
Households and entrepreneurs (SOHO)	114,4	15,5%
TOTAL	735,7	100,0%

current level of participation of ICT in the total economic growth.

2.2.3. EUROSTAT: Adjustment of organizations to technological change

The digital economy has global importance because it grows seven times faster than other sectors, but this potential is uneven in different countries. Many members of the European Union lag behind the leading countries when it comes to fast, reliable, and connected digital networks which support economy and each part of business and private life. Digital Compass for Europe 2030, EU initiative from 2021, tries to overcome technological gap and use all advantages of single digital market. While expecting its own economic revival and joining European single market.

Number of internal IT experts

On average, 10% of companies report that they recruited or tried to recruit ICT experts during the year. Among the region,

this share was highest for businesses in Belgrade (12%), Vojvodina (8%), and Central Serbia (7%). Again, there was a considerable difference by business size class: while 33% of large businesses recruited or tried to recruit specialists, the corresponding figure was just 7% for SMEs. In Serbia, more than half of the businesses (56%) which recruited or tried to recruit ICT specialists had difficulties to fill their vacancies, while the situation was worst among SMEs (61%).

IT experts are employed by 17% of SMEs, which is similar to the average in EU-27 countries. Big enterprises with workforce of more than 250 employ IT experts in 69% of cases, while EU-27 average is at 76%.

If we distribute surveyed companies by number of IT experts to those with small critical mass (up to 5 IT employees) and those with the necessary critical mass (over 5), then we see that 80% of companies employ up to 5 IT experts and therefore do not have "critical mass".

Serbian companies employ 3 times less IT experts (1.6% IT experts of total employees) than their global competition

(5.0%). The growth rate of IT employment (4%) is above the world average. Identified gap could be closed, but it will require many years at this growth rate.

IT investment structure

According to IT investment structure, IT hardware is still leading in Serbia with 43%, followed by the services of around 40%, and package software with the remaining 17%. Without more significant software projects, Serbian IT market will need decades to mature toward the structure that is present in our neighbors to the North and West, Hungary, and Croatia. Around 70% of surveyed companies has low or average-to-low software investments, which reiterates once more a weak competitiveness of domestic companies in comparison to global ones.

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

of IT investments (10% year-on-year) is above the world average.

ICT Usage in Serbian Companies

Most companies (99.7%) have access to the Internet. Most companies (81%) use mobile Internet connection via mobile devices (smart phones, laptop, tablet). Most of the companies that have an Internet connection use e-Government services (95%).

84% of companies in Serbia with more than 10 employees have a website, which is greater than the EU average. This parameter ranks Serbia to a high position (7) when comparing to EU countries. Compared to the cluster of nine Balkan countries, with 84% Serbia is convincingly number one, ahead of Croatia (69%) and the rest of the countries, up to Romania at the back (46%).

The research on the usage of PCs in Serbian companies shows that 100% of the companies use computers, regardless of their size, sector, or geographic location.

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

EUROSTAT: PREPAREDNESS OF COMPANIES FOR DIGITAL TRANSFORMATION

Digital transformation is a global trend, which came to being due to ever accelerated development of digital technologies. There is a technological gap of several decades between

Serbia and its northern and western neighbors, which pushes our country toward periphery.

There is a noticeable correlation pointing that transformation is ever harder and slower, as a country is further away from the center. Imposing question is whether digital transformation is equally noticeable in all aspects of Serbian surrounding? Judging by the data from the surroundings, we can note that digital transformation in Serbia is equally lagging in all aspects.

22% of Serbian companies use Enterprise Resource Planning (ERP), most of which are large companies (55%), then medium-sized companies (35%), and small companies (18%). Use of Customer Relationship Management (CRM) systems is at a mere 13%.

Table 7. *E-Business in companies. Integration of internal processes, 2021.*

Index	SERBIA	EU-27				SERBIA rank
		Average	Min	Max	Top21	
Enterprises who have ERP software package to share information between different functional areas	22	38	17	57	45	27

IT companies in Serbia should invest more time in getting specific knowledge about the economy in Serbia and by doing that to position themselves for future opportunities.

Furthermore, IT companies should help the technologically outdated Serbian industry with solutions that might increase productivity, innovation, and competitiveness on

Table 8. *E-Business in companies. Cloud services, 2021.*

	SERBIA	EU-27				Serbia rank
		Average	Min	Max	Top21	
Buy cloud computing services used over the Internet	29	41	13	75	58	21
Buy e-mail (as a CC service)	22	32	10	66	46	23
Buy storage of files (as a CC service)	15	27	8	63	39	24
Buy office software (e.g., word processors, spreadsheets, etc.) (as a CC service)	13	25	8	56	38	27
Buy finance or accounting software applications (as a CC service)	12	19	4	55	31	21
Buy hosting for the enterprise's database (as a CC service)	11	19	7	51	24	23
Buy computing power to run the enterprise's own software (as a CC service)	5	10	3	32	14	24
Buy Customer Relationship Management (CRM) software (as a CC service)	4	11	3	32	13	27
Buy cloud computing services used over the Internet	29	41	13	75	58	21

Source: Eurostat, Cloud computing services

the international and domestic markets. Good examples are domestic IT companies AB Soft, IIB, Digit and M&I Systems Co. as the leading ERP solution providers in Serbia, with excellent references and long tradition in business.

E-Business in companies, 2020

The survey also showed rather weak results in e-Commerce. Only 41.9% of the companies that have Internet access were engaged in purchasing goods/services online and 22% of companies were approached through the Internet to deliver goods/services.

If we look at the company structure in terms of size, we get the following:

- 25% of large companies sold products/services online
- 24% of medium companies sold products/services online
- 21% of small companies sold products/services online
- Answering the question about total revenue coming from online sales of products/services, companies gave the following feedback:
- "Less than 24%", (69,5% of the companies)

- "More than 24% and less than 50%" (20.6% of the companies)
- "More than 50% and less than 75%" (9.9% of the companies)
- "75% and above", (0,0% of the companies).

Cloud services usage in 2021

29% of the companies pays for cloud services via Internet. Cloud services are those ICT services that are accessed via Internet for the purposes of using software, data storage and similar. These services have the following characteristics:

- Located on suppliers' (providers') servers
- Can be used upon user's request
- Paid for based on way of use, capacity, space
- Over 56% of IT companies pay for cloud services

Traditional IT is ever cheaper, but is also of ever better performances, which does not help the growth of the IT market. Modern economy is based on continual growth, hence seeks new revenue sources. Since 2010, global IT market finds salvation in the Third Platform (Social, Mobile,

Cloud & Analytics, and IoT). Let us take a look at the state and usage of these solutions in Serbian companies. IT infrastructure from providers and global IT players exceeds its usage by far. The share of the cloud market in the total IT market in Serbia is five times lower than the global average and we should not find comfort in the fact that there are many countries where the situation is even worse. Similarly, mobile computing is still looking for its place in the Serbian market.

Internet of Things development is a precondition for the introduction of "smart" environments. Smart cities, smart grids, smart houses, and smart classrooms – are becoming a new reality. Thanks to a plunge in prices, different types of sensors and electronic devices have become accessible to millions of users. Several companies and institutes in Serbia are researching the best ideas for application and achieving Europe-wide recognized results. Business Analytics and Big Data comprise one of the most important pillars of future IT market growth. Practical advantages of analytical solutions for business are promoted, while confirmation of ownership of personal

data becomes a global challenge that will stay with these business models.

Conclusions:

The survey showed the usage of IT in Serbia is still in a developing phase. A high penetration of IT into Serbian households and companies has been slowed down in the last two years. The Statistical Office data showed a great market potential in providing services in introducing IT solutions such as ERP and CRM. Website development also has market potential. Demand for delivery of hardware solutions continues to remain high.

Based on a short overview of electronic business aspects, the impression is that Serbian companies are in the initial phase of digital transformation, which reflects their business environment. Organizations are mirrors reflecting the functioning of a society in which they operate. Consequently, slow digital transformation of Serbia can be seen among micro, small and medium enterprises.

Development of entrepreneurial culture and digital technologies in Serbia could contribute to economic growth and development – new jobs, revenue increase, boosting creativity and innovativeness.

Knowledge-based society and economy imply skillsets, abilities and competencies which create innovation, solve problems constructively, and bring about cooperation toward general welfare⁴.

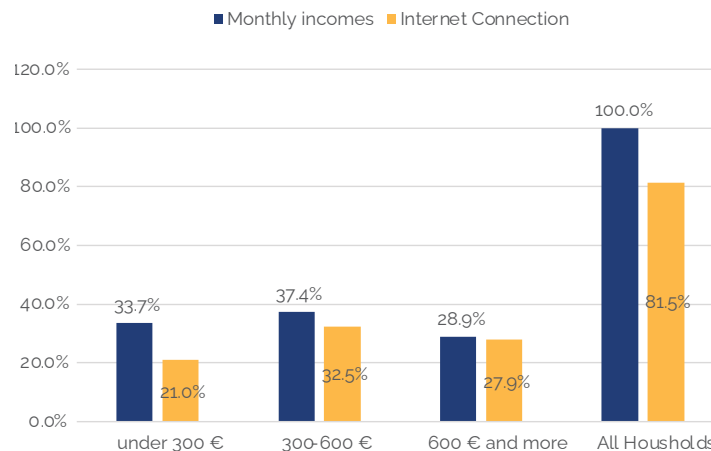
2.2.4. IT and Internet usage

Since 2006, the Statistical Office of the Republic of Serbia has been publishing statistics on the usage of ICT in households and businesses. The 2021 report showed that 76.7% of households had personal computers and 53.9% had laptop computers. The ownership of ICT equipment is mostly concentrated among the urban population with a monthly income of more than €600 (95.4%). The overall usage of computers in Serbia is still unsatisfactory, with

17.6% of the population having no access to computers. The number of PC users has increased by 2% in 2020. Among different groups within the population, students are most active in using computers (99.9%), followed by employees (91.8%).

In 2021, 81.5% of Serbian households have Internet access, which is 1.4% more than in 2019. In Belgrade, 92.9% of households have the Internet, in Vojvodina 77.8%, and in

Figure 9. *Digital Divide. Households with Internet Connection, by Monthly Income Level*



⁴ Ostojić, Petrović, 2018: 262

Central Serbia 76.1%. A digital divide, both economical and geographical, is visible.

A total of 3.6 million people in Serbia use the Internet on a daily basis. Most of them use the Internet at home (96.6%). The survey estimates that more than 1.5 million people use e-Government services in Serbia.

2.3. ICT INDUSTRY – SECTOR ANALYSIS

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

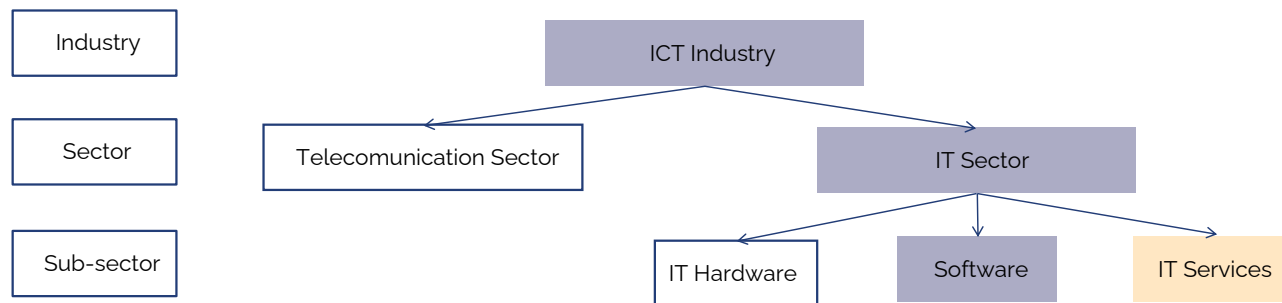
- ICT sector definition and structure.
- Number of companies, employees, revenue in the IT industry and Software sub-subsector.

IT Industry – Who sells? When it comes to the IT industry, it is not possible to summarize the results using a few statistical data. In general, the IT industry is making bigger steps than the IT market but creates a wide range of differences among companies – from failures to extremely successful ones.

2.3.1. ICT sector definition

Information and Communication Technologies (ICT) undoubtedly constitute one of the key innovations of the last century. ICT are comprised of a wide range of product and service technologies including computer hardware, software and services, and a host of telecommunication functions. Various studies define the ICT sector differently. In this report, the traditional and simple definition of the ICT sector will be applied. According to this definition, the ICT sector is divided into two sub-sectors: information technologies (IT) and telecommunications. Furthermore, the IT subsector comprises three segments, which are hardware, software, and services. The main reasons for choosing this definition are clear and simple overview of particular sub-sectors, which have not yet significantly converged in Serbia and since it is the focus of this study, to enable presentation of Software sub-sector characteristics.

The OECD defines ICT sector as a combination of manufacturing and service industries, whose products electronically capture, transmit, or display data and information. For

Figure 10. *ICT Sector Definition*

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

Since identifying those companies is not an easy task in Serbia, the excerpt from the study "Serbian IT Industry 2020", which treats this issue in detail, is used. To get the precise insight of the Serbian IT industry structure, IT companies are grouped into four clearly defined categories, relying at the same time on the NACE classes as presented in Table 8. Those categories are: (1) IT Channels - Wholesale and retail; (2) IT services; (3) Software, and (4) PC Hardware. All those

companies which did not have a clear product portfolio and are micro companies according to number of employees, are put in the category "Other – Unclassified". This classification also includes companies noticeably dealing with information technologies but coming from the converging industries: telecommunications, office equipment, and consumer/home electronics. These companies are covered by the category "Converged industry".

The data for this report is based on the nonconsolidated publicly available data of IT companies taken from their

Table 9. *OECD ICT Sector Definition.*

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

Legend: IT Industry C – IT Converged industry

financial reports for 2021 at the Serbian Business Registers Agency (SBRA) – Register of Financial Statements and Solvency.

This report is focused on Software sub-sector and the presentation of Serbian Software sub-sector through the number of IT companies, their size, structure, and number

of employees. The terms: revenue, added value, and net asset in the Serbian IT sector are used for the entire IT sector where all the active IT companies' revenues, added values, and net assets are summarized respectively [see Terminology].

2.3.2. ICT industry summary

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

In 2021, a total of 3,768 enterprises form the Serbian IT industry employed 48,173 employees representing 2% of the total workforce in Serbia. Serbian TELCO Carrier industry is formed by 126 enterprises and 14,262 employees which

is 0.7% of the total workforce in Serbia. The difference in average number of employees is noticeable: 13 in Serbian IT industry, and 113 in TELCO Carrier. The total TELCO Carrier Industry revenue is €1.99 billion in comparison to €3.93 billion in the IT industry, while an average revenue per employee is € 139,532 and €81,581 respectively.

Large growth rates contribute to growing importance of ICT sector as the healthiest part of Serbian economy. We will try briefly to shed some light on current and future position of ICT sector within Serbian economy landscape.

Table 10. *IT Industry vs. Telco Industry in Serbia, 2021. Key indicators.*

	IT Industry	TELCO Carrier
Number of companies	3,768	126
Workforce	48.173	14.262
Average number of employees	13	113
Revenue (€)	3.93 billion	1.99 billion
Revenue per employee (€)	81.581	139.532

This sector ranks somewhere in the middle, compared to other businesses, when it comes to capacities/assets, revenues, and employment. These indicators have value of 4% and 6% compared to the total of the economy and place ICT approximately at the fifth position among 13 sectors followed by official statistics.

This industry is a growth generator, in ICT growth rates of revenue, profit, and employment, are significantly above the economy's average. All this gives rise to belief that in 5 to 6 years we will see economic turnaround, when IT doubles total employment and revenues. We agree that this is a chance for revival of Serbian economy which must not be passed!

IT as a chance for an economic turnaround of Serbia

Value added, business profit and wages in the IT sector already contribute more than 5% to the domestic economy and the potential for their further growth is great. In its study on the Serbian IT industry, the SITO published that the IT industry is more profitable than other industries. Profitability

index of the IT sector per employee is 151% of the overall economy profitability index. Additionally, the sector needs for resources are significantly less than in other industries as the sector net assets per employee are close to 45% of the total economy net assets. Those IT sector features lead to the conclusion that one IT employee with half the average resources – makes profit 50% bigger. In addition, the liquidity of IT companies is twice the economy average, while debt and bank loans are at the level of 26% of the economy average. Further, the SITO found that IT companies have the highest average gross wage – 140% higher than the Serbian average. Finally, IT industry development creates the preconditions for IT experts to stay in Serbia, instead of massively going abroad.

2.3.3. Key characteristics of Serbian IT industry

The growth trend of domestic IT industry continues. In 2021, there were 3,768 active businesses, employing the total of 48,173 employees. The backbone of IT industry are small and medium enterprises. Although SMEs make just over a fifth of the total number of IT companies, according to revenues,

Table 11. *Key characteristics of Serbian IT industry according to business models, 2021.*

IT industry sub-sector	Number of IT companies	Workforce	Revenue (€mil.)	Net Assets (€ mil.)
Software	2,652	36,209	1,766.7	574.4
IT services	769	8,201	1,080.1	281.0
IT Channels – Wholesale and retail	32	1,165	773.5	97.5
PC Hardware	315	2,598	314.9	65.3
Total	3,768	48,173	3,935.2	1,018.2

•All amounts in € millions €

employees, capital, and profit – they carry two thirds of the total business activities of the domestic IT sector.

The structure of the IT industry, by industrial subsectors, is shown in the table below.

Number of IT companies

In 2021, there were 3,768 information technology companies, with individual annual revenue over one million dinars. In terms of core business, the most of this number were software companies (2,652) or 70% of the total number. In terms of size, micro companies (<10 employees)

dominated at 77%, while small and medium companies stood at 18% and 4%, respectively. There were only 21 big companies with more than 250 employees. Small and medium ones make up the main pillar of the IT sector and their number should be larger. Investments and support to the SME segment are observed as decisive factor for the fast development of IT industry.

- A huge number of micro companies (2,886), which have low financial capacities, insufficient technological and managerial skills, visibly characterizes the Serbian IT industry.
- During 2021, 676 software companies were founded. However, it took Serbian IT companies more than

a decade on average to go from startup to a big company.

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

Due to a strong focus of the Serbian IT industry on international markets and because of a very weak business environment at home, domestic IT companies face objective growth limits. This is why, most often, they include foreign partners – or relocate out of Serbia. Presently, 8 out of 10 leading software companies in Serbia are foreign owned. These companies attract and employ the best experts, as they can offer higher wages than competition.

Contradictory trends are emerging. On the one hand, the position of the largest IT companies is continuously strengthening, while on the other hand the number of micro companies continues to grow, which increases diversification within the IT industry. Such developments make it difficult

for the country to have a strategic approach to IT. Moreover, an increasing number of companies with foreign founders will make the competition even fiercer.

IT industry employees

In 2021, Serbian IT industry employed 48,173 individuals. Based on previous research, we estimate that two thirds were IT experts, and the rest is made of sales, administration, and management personnel. Compared to 1.5 million employees in all companies and organizations in Serbia, one could conclude that IT employees have a modest percentage. However, other estimates show that this is just a part of a larger number of 70,000 IT experts, which includes employees in telecommunications, those working in non-IT companies and the rest are self-employed individual IT entrepreneurs.

Employment in the software sector is growing above average, there are 36,209 employees, or 75% of the IT sector workforce. Considering the size of companies, medium IT companies employ the most (35%) of the total workforce, followed by small companies with 30%, while 21

big enterprises and some 2,886 micro enterprises employ nearly the same number – around 18%. The number of employees in 2021 was almost doubled compared with 2016, with an average annual growth rate of 10%. Compared to 2016, in fact, all companies in the sector significantly increased employment except those in IT equipment sales, which confirms development capacities of IT sector.

In the meantime, the structure according to business models has been improved toward greater IT expertise: software and IT services together employ 92% of the workforce, which is some 15 percentage points more than in 2016. Decrease of employment can be expected only with hardware companies. Number of certified experts in the companies prevalently working with PC equipment is very small. These companies, for years now, cannot retain IT experts, losing their competitiveness and will be increasingly less important in the IT industry.

Revenues

In 2021, a total revenue of Serbian IT sector reached €3.93 billion, which is an increase of 18%, compared to the

year before. We estimate that revenue from IT business amounts to nearly €3 billion, while the remaining revenue comes from IT-converged or non-IT activities in the sector. Software export growth rate is considerably higher than that of the domestic IT market. All of these are unfavorable indicators and make lagging of Serbian economy and society digitalization starkly obvious.

The highest business revenue in the IT industry comes from software sub-sector with €1.8 billion or 45% of total revenues. Considering size, small, and medium IT companies together make €2.7 billion, which is 68% of total IT industry revenue. The remaining 32% is evenly distributed among micro and large enterprises.

Serbian IT industry capital

In 2021, Serbian IT owns €1 billion and records 10% annual growth. The fourth year in a row, capital of IT industry grows by a double-digit rate. Also, comparing to 2015 when capital amounted to around €470 million, Serbian IT industry is valued 100% more. Such a trend additionally

boosts foreign capital, since among the 100 biggest IT companies only almost one half is foreign owned. Foreign companies bring international standards into Serbian IT, but it also imposes the necessity to adjust and, in a way, localize foreign companies in order to be successful in Serbia.

Software companies own most of the sector capital, over €574 million or 56% of the total capital in the Serbian IT industry. Distant second are IT services companies, with €281 million or 28%.

2.3.4. Software sub-sector

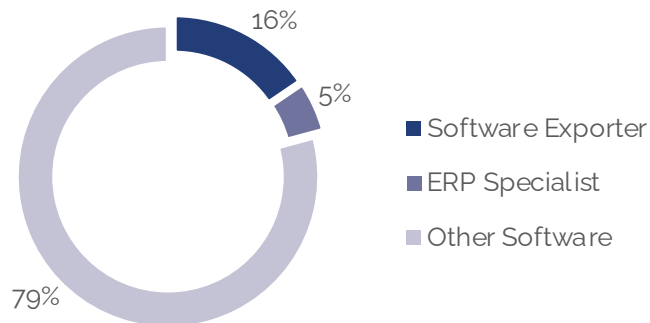
Number of software sub-sector companies in Serbia

In respect to company activity, the software sub-sector dominates in the Serbian IT industry with 2,652 enterprises, which is 70% of the total number of enterprises in the IT industry. Enterprise distribution according to their size and Software segment is presented in the table below. The key subgroups: (a) software exporters are companies that generate the majority of their income through software export, (b) ERP solution providers are active on the local

Table 12. *Number of companies according to the segment and Company size, 2021*

Software segment	Micro Enterprises	Small Enterprises	Medium Enterprises	Large Enterprises	Total
Software Exporter	77	198	122	14	411
ERP Specialist	72	62	7	0	141
Other Software	1,829	267	4	0	2,100
Total	1,978	527	133	14	2,652
Total [%]	74.6%	19.9%	5.0%	0.5%	100.0%

Figure 11. *Distribution of Software sub-sector according to segment, 2021*



Source: SITO, 2022

market only, (c) others – all other software companies. This segmentation reflects the particularities of the Serbian software sector well.

Key comments for table 12:

- In the Serbian Software sub-sector, there are only 14 big IT enterprises (with more than 250 employees). The total number of SMEs is 660, which is 25% of the total enterprise number in the Software sub-sector. The number of SMEs in this sub-sector should be significantly

higher. Investments and support to the SME segment are necessary and pivotal factors for the fast IT industry development.

- A large number of micro companies (1,978), which have low financial capacities, insufficient technological and management skills, visibly characterize the Serbian Software sub-sector. The situation is further exacerbated due to the significant number of Software enterprises in the category "Other Software" with 2100 enterprises of which 1829 are micro enterprises.

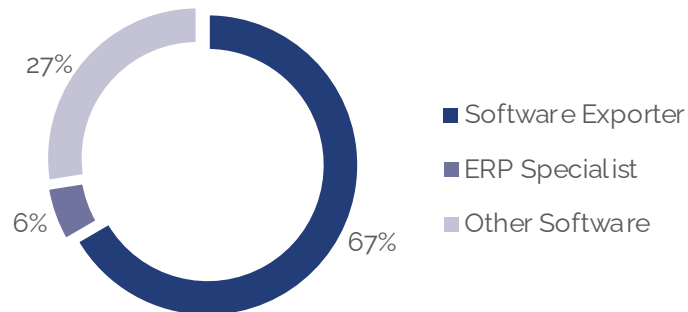
Workforce in Serbian Software sub-sector

The employment in Software sub-sector increased significantly above average in 2021 and achieved the number of 36,209 employees, which is 75% of total IT sector workforce.

In the period 2016-2021, employment rose 3 times, which is an impressive annual growth rate more than of 20%. Under such circumstances, we can expect further growth up to 20,000 employees in the coming three years. The workforce

Table 13. *Workforce in Software sub-sector according to the segments and Company Size, 2021*

Software segment	Micro Enterprises	Small Enterprises	Medium Enterprises	Large Enterprises	Total
Software Exporter	401	4,781	12,666	6,274	24,122
ERP Specialist	305	1,301	519	0	2,125
Other Software	4,557	4,977	428	0	9,962
Total	5,263	11,059	13,613	6,274	36,209
Total [%]	14.5%	30.5%	37.6%	17.3%	100.0%

Figure 12. *Software segments Share (%) in Total Number of Employees in Software sub-sector, 2021*

Source: SITO, 2022

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

Key comments for table 10:

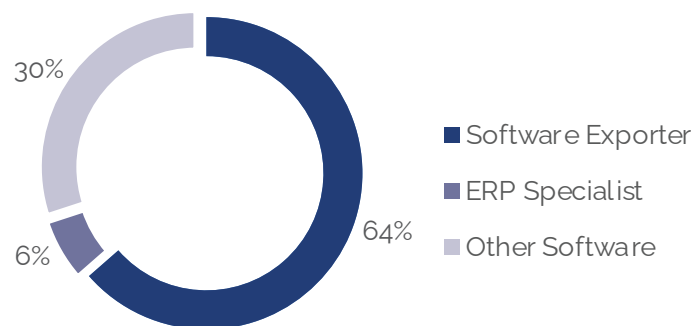
- The largest number of employees 24,122 (67%) is in the "Software exporter" segment, followed by the "Other Software" 9,962 employees which is 27%. The lowest number of employees is in the "ERP Specialist" segment (6%). However, this distribution is expected to change due to the Software sub-sector expansion and growing importance of large and medium enterprises.

- The Medium segment in Software sub-sector records significant number of employees (13,613), which is 37.6% of the Software sub-sector segment workforce. Average number of employees in Software SME segment is 37, more than 2,8 times bigger than IT industry average (13).

Revenue in the Serbian Software Sub-Sector

In 2021, total revenue of the IT industry in Serbia reached €3.93 billion, an increase of 18% over the previous year. The highest part of revenue, 45% of it, was generated in the Software sub-sector (€1,77 million).

Figure 13. *Revenue Structure of Software Sub-Sector (%), 2021*



Source: SITO, 2022

Table 14. *Revenue in Software sub-sector [€ million], according to the segment and Company Size, 2021*

Software segment	Micro Enterprises	Small Enterprises	Medium Enterprises	Large Enterprises	Total
Software Exporter	31.2	224.4	584.0	283.2	1,122.8
ERP Specialist	15.7	69.6	28.1	0,0	113.5
Other Software	264.7	208.7	57.1	0,0	530.5
Total	311.6	502.7	669.2	283.2	1,766.7
Total [%]	17.6%	28.5%	37.9%	16.0%	100.0%

The revenue of the IT industry represents the revenue of the whole IT sector – all IT companies revenues summarized. Compared to the value of the IT market, the IT industry revenue is typically three times higher, due to selling multiplications in distribution channel, export, and non-IT revenues of companies' business. Distribution of the Software sub-sector revenue is in the Table 14.

Key comments for the table above:

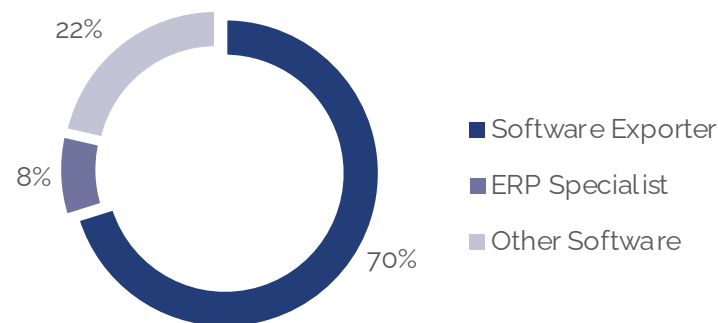
- In comparison to 2020, Serbia's total Software sub-sector revenue in 2021 rose 20%, which is twice more than the whole IT market growth. The reason lies in the strong growing "Software exporter" segment. In the five-year period 2017-2021, the revenue grew 3 times, making an impressive average annual growth rate of 25%. In these circumstances, a doubling of revenue over the next three or four years would come as no surprise.
- The highest revenue, 64% Software sub-sector revenue, was accomplished in the "Software exporter" segment (€1.1 billion). It is followed by "Other Software" segment with €530 million (30%).

- With revenue of almost €1.2 billion, the SME segment generated a 67% share in total Software subsector revenue. In the same segment, the biggest part, also, came from the "Software exporter" – more than 2/3 of the total SME segment revenue.

Capital of the Serbian Software Sub-Sector

The biggest net assets, over €574 million, which is almost 56% of the total IT industry net assets, are held by the

Figure 14. Structure of Software Sub-sector (%) in Net Assets, 2021.



Source: SITO, 2022

Table 15. *Net Assets of Software sub-sector [€ million], 2021.*

Software segment	Micro Enterprises	Small Enterprises	Medium Enterprises	Large Enterprises	Total
Software Exporter	41.4	58.9	187.6	115.1	403.1
ERP Specialist	4.0	29.9	14.4	0.0	48.3
Other Software	66.4	40.8	15.8	0.0	123.0
Total	111.9	129.6	217.8	115.1	574.4
Total [%]	19.5%	22.6%	37.9%	20.0%	100.0%

companies in the Software sub-sector, followed by the IT Service (28%). In the five-year period 2017-2021 capital rose almost 2.5 times, representing an average annual growth rate of 20%. In these circumstances, over the next 3 years an increase in capital of more than €200 million is expected.

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

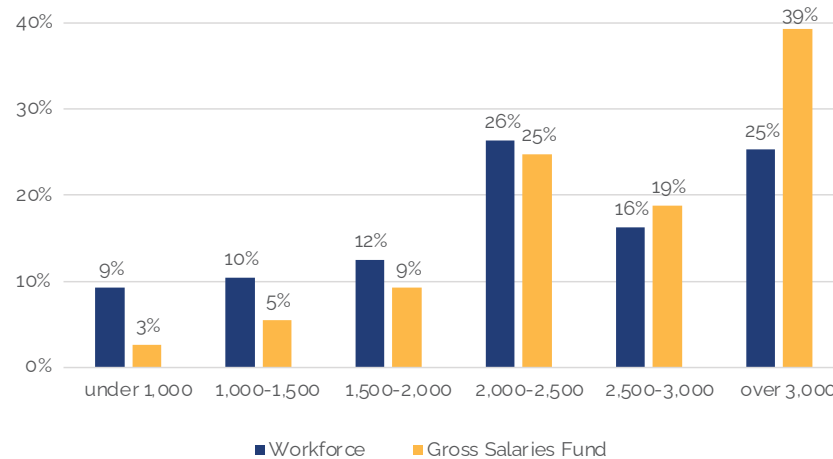
Key comments for table 17:

- The biggest net assets, round €403 million and almost 70% total Software sub-sector net assets, are held by the companies in "Software exporter" segment.
- With €347 million, the SME share was 60% in Software sub-sector net assets in 2021.

Salary in the Serbian Software Sub-Sector

The average gross salary⁵ span by companies' specialty is from €895 for PC Hardware to €2,435 for IT services.

⁵ An average salary is calculated per one employee for each of the companies over total salary costs – which includes total net salaries with contributions paid by the employer (Gross 1) and other personal expenses.

Figure 15. *Distribution of employees and fund of total salaries, by average salary pay grades***Table 16.** *Salary in Software sub-sector according to the segment and Company Size, 2021*

Software segment	Micro Enterprises	Small Enterprises	Medium Enterprises	Large Enterprises	Total
Software Exporter	2,142	2,314	2,594	2,706	2,560
ERP Specialist	1,080	1,737	2,257	-	1,770
Other Software	1,718	2,000	2,176	-	1,930
Total	1,709	2,113	2,568	2,706	2,383
Total [%]	72%	89%	108%	114%	100%

The average gross salary in the software sub-sector is €2,383 which is similar to the total of the IT sector (€2,329). Salary ranges within the category and within the companies are even greater, which depends on the experience and expertise of the individual employee.

Average gross salaries in Software sub-sector are presented in Table 16.

A distinction must be made between the cost of profit per employee and salary, as the latter is just a part of the profit. With system integrators, salaries are an individual category, as it is in the entire IT sector.

Key comments for table 16:

- The average salary in software exporting companies is €2,560, which is higher than the sub-sector average that has reached €2,383.
- Software exporting companies employ 50% of the total IT workforce in Serbia, while the gross fund for exporters' salaries is 60% of the total fund for salaries.
- The largest portion of average salaries (26% of the total) is

within €2,000 to €2,500 range. If we look at the ownership, salaries make up a major part of the total revenues with the companies where founders were international (typically, more than 70%), unlike local founders where this figure is less than 40%. International founders keep their daughter companies in Serbia on budgets dominated by the salary's percentage.

Higher wages have become the main instrument of IT companies in attracting candidates for jobs. Current demand for IT experts is far stronger than the offer, which created labor market disturbance. The trend of continual increase in levels of salaries leads to the increase of expectations expressed by junior programmers, who want net salaries of more than €1,000. It is not easy to define real salary levels of IT experts in Serbia today. It became an individually determined value within a wide range.

Differences among companies, within a company, between positions, experience etc., range from 1 to 10 (order of magnitude). All that are looking for a job have their eyes fixed at 10x. Therefore, the appeal of IT studies is stronger

than ever and attracts “hesitant” candidates who are aware of the fact that these IT studies will help them in the quest for a well-paid job.

Higher wages have become the main instrument of IT companies in attracting candidates and the current demand for IT experts is far stronger than the offer.

2.3.5. Gender representation

Over 50,000 people work in Serbian IT industry, which makes a small part (1.8%) of 2.73 million inhabitants with working capacity in 2022. In EU-27, IT workforce makes 2.1% of the total workforce, while women in IT make 0.5% of the total workforce. Serbia has an important task to raise employment in IT business to 2% of the total workforce and at the same time increase participation of women.

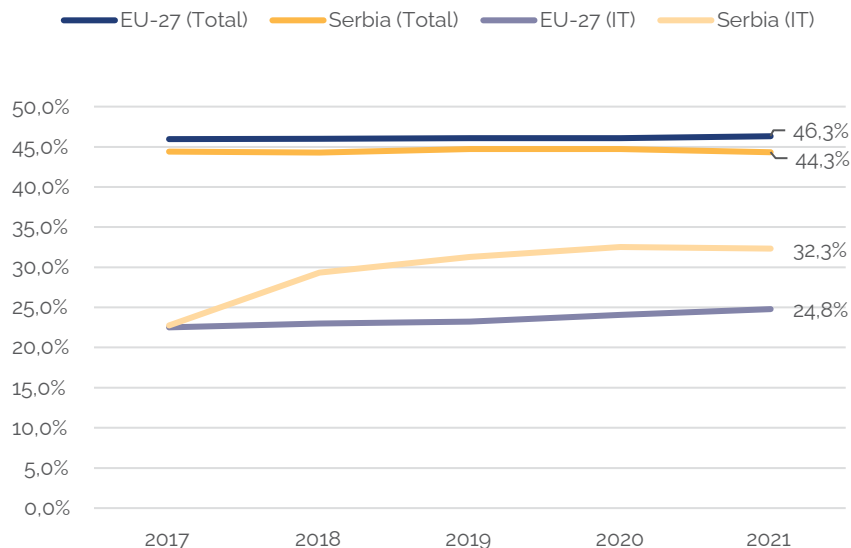
There is another peculiarity in connection with gender representation in IT sector. Namely, female representation in administration and other services is higher than in

technical-technological parts of IT businesses. Almost 80% of workforce within IT sector companies are different profiles of IT experts, while the remaining 20% are in supporting activities of administration, HR, finances, legal, marketing etc.

All the data in this section are publicly available at the Eurostat website. The figure below shows the data on participation of employed women in the total economy and in the IT industry (NACE J62) in the period 2017-2021.

Key observations:

- In 2021, the IT sector (NACE J62) in Serbia employs 50 thousand people, out of which 16 thousand are women. Participation of women in the IT sector in Serbia has reached 32%, which is higher than EU-28 average (25%).
- Serbian IT sector has increased total employment in 2021 by around 12,000 people, where 60% of newly employed are man and the remaining 40% are women. This is a continuation of the increase of participation of women in the new jobs. In the period 2017-2021, female workforce

Figure 16. *Serbia and the EU-27: Employment of Female in total economy and IT, 2017-2021*

in the IT was increased in Serbia from five to 16 thousand, while total employment in the IT sector went from 22 thousand to 50 thousand people.

- The countries with the highest participation of women in the IT (NACE J62) are Romania (36%), Bulgaria (31%), Cyprus (30%), Lithuania (30%), Estonia (29%) and Croatia (28%).

- The countries with the lowest participation of women in the IT are Belgium (21%), the Netherlands (20%), Slovenia (19%), and Czechia (13%).

We estimate that less than 20% managerial positions are filled with women, and in less than 10% of cases women are in company leadership positions.

Participation of women in the IT sector in Serbia has reached 32%, which is higher than EU-28 average (25%).

When it comes to interest of girls who are finalizing their education nowadays, there is a distinct division to Eastern and Western Europe. Only 1% of girls on average, across OECD countries, reported that they want to work in ICT related occupations, compared with 8% of boys who so reported. In some countries, including Bulgaria, Estonia,

Lithuania, Poland, Serbia, and Ukraine, more than 15% of boys reported that they expect to work in an ICT-related profession. However, in no PISA-participating country or economy did more than 3% of girls report the same.

Note: the IT industry in this chapter comprises the key economic activities J62 in the NACE classification (excluding C26). This is a major, but not complete, scope of IT industry. As such, it is still representative from the point of view of women's employment data.

3

SOFTWARE SECTOR – OPPORTUNITIES ON INTERNATIONAL MARKET

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

- Export-oriented software sector – Current situation
- Trends and potentials
- Opportunities and barriers for Serbian IT companies

Identification and evaluation of Serbian Software sector has to rely on the description of the current situation in Serbia, local and global IT trends identification and analysis, and on the potentials for Serbian companies that are arising from the identified trends. [Source: SITO, 2022]

3.1. SOFTWARE EXPORT SECTOR – CURRENT SITUATION

A total of 411 active enterprises, whose predominant activity (revenue) is software and IT service export, make the Serbian software export sector in 2021. The total number of employees is 24,122 and represents 51% of the total IT workforce in Serbia. The average number of employees

Table 17. *Basic Business Indicators of Software export sector vs Top15 in 2021.*

Software export sector	2021	Top 15	Index -Top 15 (%)
Number of Companies	411	15	4%
Workforce. Number of Employees	24,122	5,818	24%
Average Number of Employees	59	388	661%
Revenue (€)	1,122 million	327 million	29%
Revenue per head (€)	46,547	56,316	121%
Added Value (€)	926 million	285 million	31%
Added Value per head (€)	38,395	49,098	128%
Net Assets (€)	403 million	170 million	42%
Net Assets per head (€)	16,709	29,255	175%

Source: SITO, 2022

is 59 and the average revenue and added value – per employee, were €46,547 and €38,395 respectively.

In 2021 the total revenue of the software export sector is €1.1 billion, whereas the export of the Serbian computer and information services is much higher (€1.7 billion). The difference comes partly from the large system integrators'

and software companies' exports, while their predominant revenues are from their activities on the local market. Apart from that, the big IT international players present on the Serbian market through their local branches, such as MICROSOFT; IBM, HP, CISCO, ORACLE, and SAP, are largely on their corporate budgets, which makes their currency inflow obvious. So that local branch-offices, such as

MICROSOFT, IBM, HP, CISCO, ORACLE, and SAP, generated more than €100 million from export. A similar amount (€100 million) was exported by the system integrators, while the rest of €200 million came from many others.

Business concentration on Top 15 Software Exporter

Business concentration of Serbian Top 15 software exporters has been decreasing year after year, illustrating their slower growth rate than the sector's average. Fifteen biggest software

exporters according to the revenue in 2021 employing 24% of the software export sector workforce generated 29% of the sector's revenue and 31% of the sector's added value. Net assets of top 15 are 42% of the total sector's asset.

3.1.1. Who are the software exporters in Serbia?

406 IT companies, which generated the majority of their revenue through export of software and IT services, were

Figure 17. *Business concentration [%] on top 15 Software Exporters in 2021.*

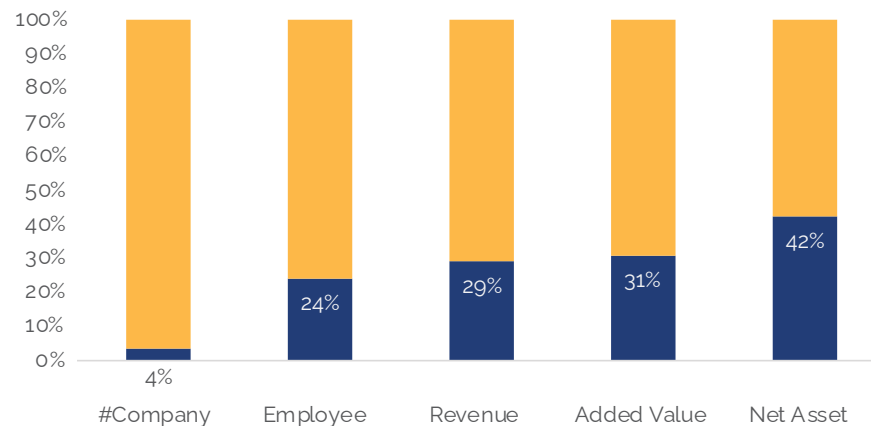


Table 18. *Ownership structure of IT companies, 2020*

Software Exporter segment	Number of companies	%	Employees	%	Revenues (€)	%
Foreign ownership	184	45%	13,029	62%	556 mills	61%
Domestic ownership	178	44%	7,226	34%	326 mills	36%
Unknown	44	11%	702	3%	30 mills	3%
Total	406	100%	20,957	100%	913 mills	100%

doing business in Serbia in 2020. According to ownership structure, there are almost equal numbers of companies with foreign owners (45%) and domestically owned companies (44%). Foreign-owned software exporters employ 62% of the workforce and create 61% of revenues. We can freely state that nowadays foreign owners control and manage around 60% of the software export capacities, with a tendency of growth of this percentage each year. This way, Serbia loses the possibility to include the healthiest part of the IT sector in future strategies and actions.

Each year, number of IT companies that export software increases, but capacities mainly accumulate in companies

that do business for more than five years. When we take a look at the concentration of business in 200 leading software exporters, we realize how big it really is. This stronger half of the sector creates 90% of the total revenue and employs 86% of the workforce of all software exporters. This means that the remaining 206 smaller companies dispose of far smaller capacity for software exports.

In the analysis of revenues which comes from workforce hire (outsourcing) and from selling own software solutions, we have analyzed the 200 largest software exporters. Among 200 major exporting companies and according to the generated revenues, 129 of them is in outsourcing,

while the remaining 71 generate most of their revenues by selling their own solutions. Outsourcers employ 77% of the workforce and generate 69% of the export revenue.

In terms of ownership of the 200 biggest IT exporters, 112 were founded by foreign persons or companies (first

quadrant below), employing 67% of the workforce and generating 64% of the export revenues – dealing almost exclusively with outsourcing.

Table 19 illustrates the present Serbian Software export scene and those who have recognized the chance offered

Table 19. *The ownership and organizational form of leading software exporter in Serbia, 2021*

	Other	Business company (LLC)
Foreign Ownership	BRANCH-OFFICE (MICROSOFT, HPE, IBM CISCO, ORACLE, SAP) Employment agencies (4)	SCHNEIDER ELECTRIC DMS LEVI g GLOBAL SOURCING NORDEUS ENDAVA EFRONT HTEC IGT SEVEN BRIDGES ... (1)
Local Ownership	Entrepreneurs & Individuals (Free-lance, Start-ups, Small IT agencies) (3)	RT-RK VLATACOM COMTRADE S.E. HDL DESIGN HOUSE ... (2)

Source: SITO, 2022

by export. It shows the two dimensions of the software exporters: ownership and organizational form. The quadrant is divided into four regions: the vertical axis represents the ownership: local/foreign, and the horizontal axis the organizational form: business company (LLC)/others.

Key observations from the quadrant are:

In the first quadrant (1), the seven leading software exporters with foreign ownership are listed representing the major outsourcing resource in Serbia: in revenue, the number of employees and in investments. Big investments in this sector started with SCHNEIDER ELECTRIC DMS NS since October 2012, while IGT (GTECH) has been characterized with smaller, but continuing investments for more than a decade. These two leaders are focused on their own products development and the needs of the global market. Seven Bridges is the leading biomedical data company, specializing in software and data analytics to drive healthcare research.

Mostly, others from the first quadrant are Outsourcers who provide programming (coding), testing software, designing

websites, and developing solutions in the embedded industry. The second quadrant (2) includes very important Software export business companies owned locally. Four companies listed in this quadrant are the leading ones among numerous domestic software export companies.

Local companies are almost evenly divided into outsourcing and selling own solutions, which will not be enough to change the structure of the entire IT export in the near future. Therefore, outsourcing will dominate the export even after 2022.

In the third quadrant (3), there are entities with local ownership, categorized as "Other" – which refers to Entrepreneurs and Individuals. The specific significance of the freelance market has to be further explored as on the one hand, this group involves an unknown number of readily available skills and expertise and, on the other, a large group of individuals without the economic basis or chance for permanent employment and with all the difficulties coming with this status⁶. In this quadrant, one of the common forms of software business organization is a small entrepreneur IT

⁶ As we reported in the previous report, banks in Serbia started to recognize registered entrepreneurs as prime candidates for bank loans, thus mitigating some of the important setbacks inherent to their status, such as non-existence of credit rating and ability to take loans.

agency. Finally, this quadrant may also include startups at incubators, innovation centers and clusters. Start-ups should be supported and stimulated as one of the transitional forms from freelance to company status. Educational and motivational programs could help relocating significant Outsourcing corpus from quadrant (3) Entrepreneurs and Individuals to quadrant (2) Business companies.

The fourth quadrant (4), which contains branch-office and employment agencies, represents the informal set of business activities, which foreigners use before the formal beginning of the outsourcing business in Serbia. Local branches of big international players: MICROSOFT, IBM, HP, CISCO, ORACLE, and SAP are also classified in the fourth quadrant (4). Although software export is not on their business line, their main business activities are a significant part of IT service export from Serbia.

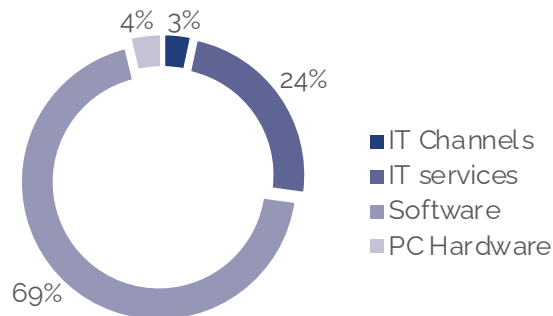
For now, greenfield investments are more often than not present in Serbian outsourcing, while acquisitions, although less frequent, are reserved for the biggest deals (for example NORDEUS and SCHNEIDER ELECTRIC DMS). More

acquisitions are expected in the future, as practice shows that domestic IT companies with yearly revenue exceeding €10 million are becoming interesting to foreign investors.

Outsourcing sector development has to be tracked and supported by future analysis that include more precise classification of the outsourcing entities, due to all of their particularities. International IT companies advance into the Serbian IT market attracted by its potential. Local companies are exposed to a strong globalization effect, but at the same time the global IT companies are exposed to the need of localization: to establish their own companies and local offices and employ Serbian workforce. The international IT vendors in Serbia have strengthened their local presence significantly in the past years by establishing their own companies for global services.

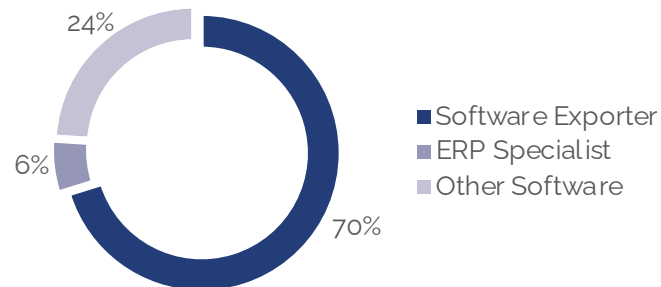
3.1.2. Added Value in the Serbian IT Industry

The software and IT services became the most challenging markets. System integrators and software companies who recognized the fast-growing service market and jumped

Figure 18. Structure of IT Industry (%) in Added Value, 2021

on that wagon, achieved success. Additionally, companies that partnered with global IT vendors progressed rapidly thanks to the adoption of global IT experience and expertise.

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

Figure 19. Structure of Software Sub-sector (%) in Added Value, 2021

Source: Register of Financial Statement and Solvency, SBRA, prepared on SITO's demand

Serbian IT companies have accomplished total added value amounting to €1.9 billion, which is 48% of the IT industry revenue in 2021. This amount makes 4% Serbian GDP – an obvious increase in comparison to 1% ten years before.

Key comments for figures 18 and 19:

- Software sub-sector with 68% share achieved the highest added value (€1.3 billion), IT services sub-sector follow (24%), and IT Channels sub-sector (4%) is in third place.

- The SME segment accomplished €1.2 billion in 2021 and 65% share in total added value of the IT industry.
- Software export sub-sector of the Software sector amounted €926 million; 70%). It is the largest part and illustrates its significance and potential.

3.2. SOFTWARE EXPORT SECTOR – TRENDS AND POTENTIAL

According to the National Bank of Serbia, exports of computer services grew at a rate of 30% and amounted to €1.73 billion, while imports grew at a lower rate (8%) and reached €440 million. The positive balance in the export of computer services in 2021 amounted to €1.29 billion, which is an increase of 40% compared to 2020. This is a big step forward for the Serbian economy. The coverage of imports by exports is still high (392%) and should grow – or at least keep it at this level.

Additional comments on the above figures:

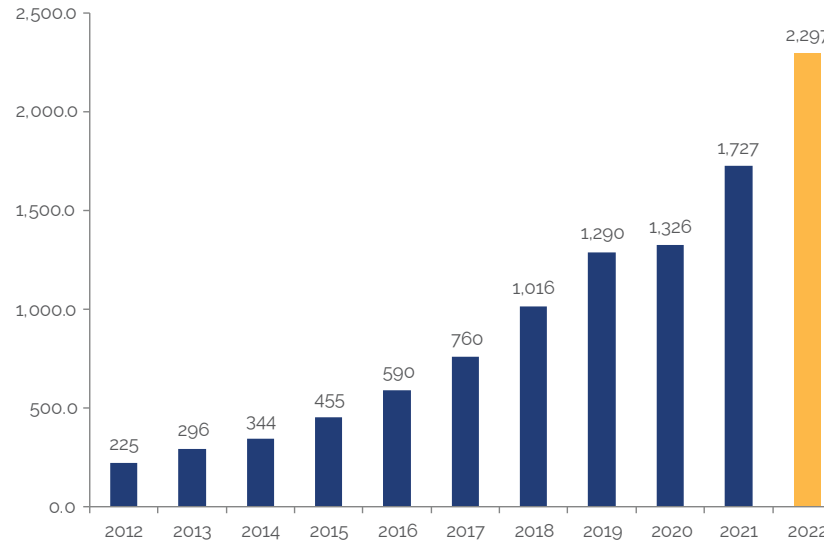
- The analysis of ICT exports shows that the export base in 2012 was low, which enabled the beginning of high

growth rates. However, the continuous development of the sector until 2021 has created significant cumulative effects and this picture has improved significantly today.

- The strong growth of Serbian exports of computer services in 2021 is equally driven by rising labor costs of developers and increased workload.
- Serbia's share in global exports of IT services is currently estimated at about 0.4% of world exports and there is room for further growth.
- There is a strong trend of further growth of global demand for IT services, followed by rising prices of IT services.

It is currently slowing down the recruitment of domestic IT professionals, which is insufficient compared to the demand of IT exporters.

It seems that even the threat of a global political and economic crisis does not harm IT businesses. Strong technological transition is under way and all the big economies see new technologies as a way out of crisis – all major players invest heavily in technological development.

Figure 20. *Export of Computer and Information Services [€ million], 2012-2021 and trend 2022*

Source: Register of Financial Statement and Solvency, SBRA, prepared on SITO's demand

Despite all the threats of global storm, further growth of IT market is wanted. The dilemma rises: should IT business park in a safe spot – or boldly press on? It will all depend on individual decision makers. Analysis and data that follow can assist many decision makers in the exciting times ahead of us.

The software export share in GDP has been rising year after year (from 0.3% in 2008 to 1.0% in 2013 and to 3.5% in 2021). The main reason is a significantly faster growth rate of the Software export sector in comparison to the rate of the remaining part of the Serbian economy, so it becomes the healthiest part of the economy. If Serbia is

to become a respectable offshore destination for software development, the ratio of IT services export to GDP has to be higher than the current 3.5%.

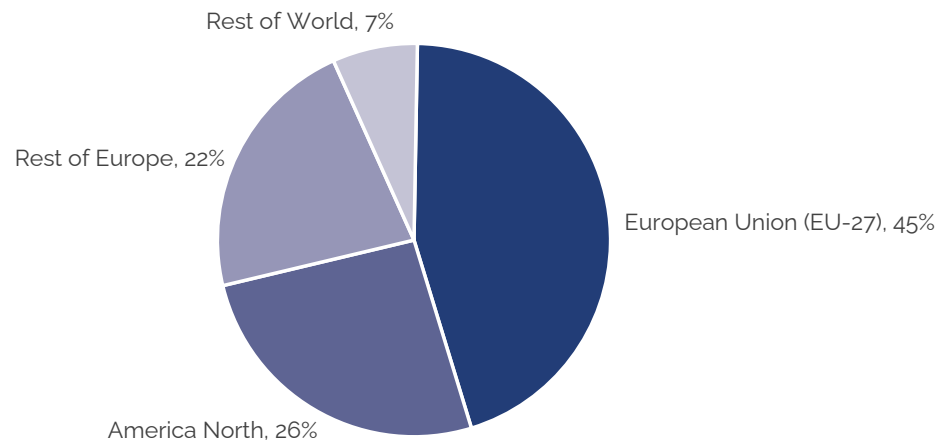
Competitiveness of Serbian providers of computer services

Computer services are used globally as an indicator for comparison of countries and levels of their technological development. Serbian internal market of IT services grows

at an annual rate of just over 10%. On the other hand, export of computer services grows more than 30% annually. This improves the image of Serbia and moves it from a country of cheap labor toward a country with high-quality human capital.

According to the WTO data, global export of computer services has been increasing in the period 2016-2020 at an annual rate of 12% and reached €500 billion in 2020. Serbia took the 42nd position in 2016 and moved to the 36th place according to the 2020 data. In 2021, the estimates

Figure 21. *Serbian export of computer and information services by territory, 2020 [€ million]*



are that Serbia climbed one or two steps. In comparison with the countries in our region, Romania, and Hungary, are positioned better in computer services export, while Serbia ranks better than any other neighboring country.

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

Top five Serbian export markets by country are: United States of America (22%), United Kingdom (11%), Germany (9%), Switzerland (8%) and the Netherlands (6%).

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

By the optimistic estimate, Serbian IT export could exceed €2.5 billion in 2025. In any case, IT in Serbia will continue to grow as before – spontaneously riding the wave of global

technological progress. If the Government decided to get involved, but in a smart way and with measures to support the IT industry, then the €2.5 billion estimate could be surpassed.

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

Total SW Export = Outsourcing export + Own Solutions export
Outsourcing accounted for about 75% of total IT exports in 2021. The Serbian export-oriented IT sector is predominantly owned by foreign capital and the business stability of these companies is provided by revenues generated on international markets, outside Serbia. Based on previous market activities, we can expect that these companies will double their workforce in Serbia by 2025 and the number of employees is a key growth factor in their business model. Those revenues will have reached €2.5 billion in that period.

On the other hand, IT companies that export their own solutions create more than double revenues per employee,

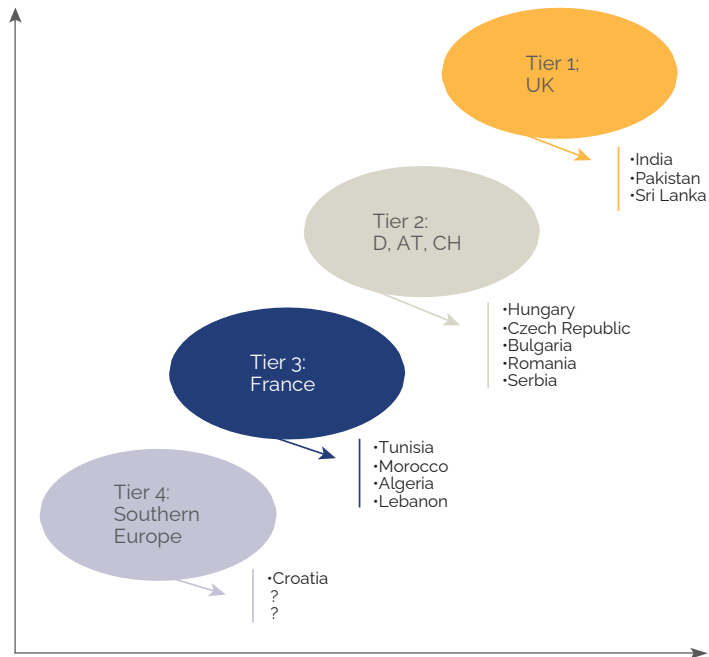
compared to outsourcing model. Still, it is hard to expect that the Serbian companies would manage to use their own solutions to secure more than €500 million in exports by 2025. Why? Because as soon as the annual revenue of any local company tops €10 million, their business moves abroad or is sold to a foreign owner. After that, the budget left in Serbia is for salaries only and the business of these IT companies becomes similar to the outsourcing model.

With the continuous and spontaneous approach, there are minimal chances for any significant model changes by 2025 and outsourcing will, unfortunately, remain a dominant part of the Serbian IT export. Strong support of the Government to companies which develop global solutions and improve their business model in outsourcing would be wise, while trusting domestic companies in big procurements of IT products and solutions would be a huge step in the right direction. Such a role of government, along with proposed goals, were made obvious in the recent work on the development of Smart Specialization Strategy (RIS3) in Serbia. References and experience gained in this way would help achieve own solutions export more than €500 million

in 2025. All this would help create a vibrant environment and the eco-system in which domestic technology companies could create even larger added value in Serbia. Also, stability/safety of such domestic IT solutions is typically stronger than relying on foreign IT solutions in Serbia.

3.2.1. Global and EU market trends and offshore outsourcing potentials

In the period 2016 – 2020, global export of IT services grew from €316 billion to €501 billion, which means there was an average monthly rate of growth of 12%. In the same period, Serbian export grew at an average annual rate of 22%. Participation of Serbia in global IT services export amounts to 0.3% and there is plenty of space for further growth – but to get there, we will need IT experts that we do not currently have. For example, to achieve more than €3 billion of IT exports in 2023, and with the dominant business model of outsourcing (workforce loan), we will need additional ten thousands IT experts. If the focus should move toward production of solutions made in Serbia, we would need five to six thousands experts for the same goal.

Figure 22. *Intro-European Offshoring Market Growth Pattern*

Source: GOPA Consultants

Considering global and German market trends, the (offshore outsourcing) potentials for Serbian companies have become clearly visible. Exploitation of these potentials by Serbia can be built on several factors: the preference

of European companies for nearshoring to Eastern and Southeastern Europe due to the proximity and cultural issues, positive cost-benefit-ratio of relatively lower-cost but skilled labor (combined with lack of experts in some markets like Germany), solid language skills, and rising wages in some markets (like India). The trend towards smaller and shorter projects additionally helps Serbian SMEs. A strong position and the growth predictions can be seen in the following chart where Serbia is listed as a mature market with respectful market volumes.

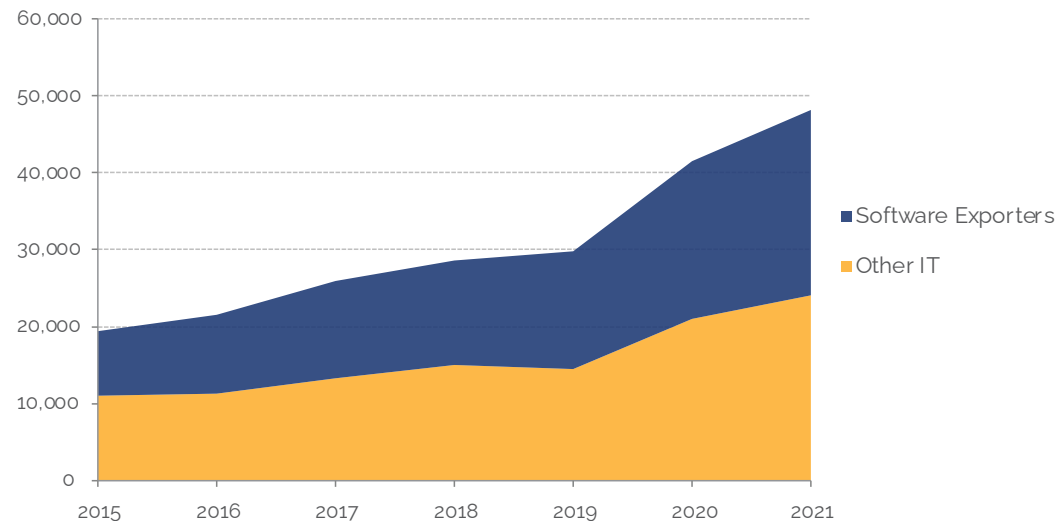
Regional market of Southeast Europe (that includes Western Balkan countries) in the picture above, is not visible as it is of a small volume and immature. This market is expected to grow and become visible in the foreseeable future. Serbian IT companies expect to benefit from the following dimensions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

3.2.2. Workforce trends and potentials

There are 50 thousand people working in the Serbian IT industry, which is double the number from 2016. In the period 2016-2021 an average increase of 14% per year was recorded. Under the current circumstances and in a similar business climate, we can expect further two-digit growth

rate. If the IT industry retains the annual growth rate of around 15% in the next five years, then the total number of employees would certainly exceed 70,000 in 2025. This is an excellent example of how continual high growth rates can revolutionize things within a decade. The rate of 15% doubles the value in 5 years and after 10 years it produces four times higher values than those from the beginning of the cycle.

Figure 23. *Workforce of software exporters 2015-2021*



Source: SITO, 2022

The challenge of further growth lies in the fact that education system manages to create around 4,000 ICT experts each year, while demand is over 7,000. Intensive and massive re-qualifications and trainings are needed for the IT sector to keep the existing tempo and reach 70,000 employees in 2025. Maybe these numbers seem unrealistically high and optimistic, but this is also an increase of participation of the IT workforce in the total Serbian workforce from 1.5% to 3%. The figure of 2% is current average in the EU countries. One of buffers (reserves) we can count on – are women. With the right motivation, more individuals from the young female population can make IT professions their choice.

It would be great to see creation of balance between employment of IT experts for domestic needs on one hand and for foreign markets on the other. Any neglect of domestic needs will rapidly lead toward higher imports of software and IT services. We spoke earlier about the need for development of domestic IT market worth over €1 billion, which reflects in around €150 IT investments per capita. It also reflects a minimum of achieved EU standards, which made accession possible for new member states

from the East. Such a level of investments requires at least 20,000 IT experts focused almost exclusively on domestic economy and market. Currently, less than 15,000 experts are working there. If, however, the trend that the majority of newly employed work for international markets continue, then there will be no other choice but to buy (more expensive) foreign solutions instead domestic ones that would be more favorable on more than one level.

There are numerous tasks before the Government and certainly the most important task is educating the IT staff in larger numbers, as those are the main moving force of the entire IT development, with the state being the major founder and financier of almost all higher education institutions. That is why investments in this area have to be as big as possible, while additional action is needed to minimize brain drain. We are facing big challenges regarding raising the quality and quantity of IT studies. However, demography is not on our side, so the question of the good measure and maximum achievements is becoming essential. Regarding the capacities for studying, we are probably nearing the maximum, while there is always room for raising quality.

Stagnation in the workforce of top software exporters

As an illustration of the Software export sector dynamic progress, we used the workforce growth rate of the 6 leading companies in the period 2009-2021.

Key observations for Figure 26:

In 2016, total workforce of 6 leading companies in the Software export sector was 2,467 employees, which

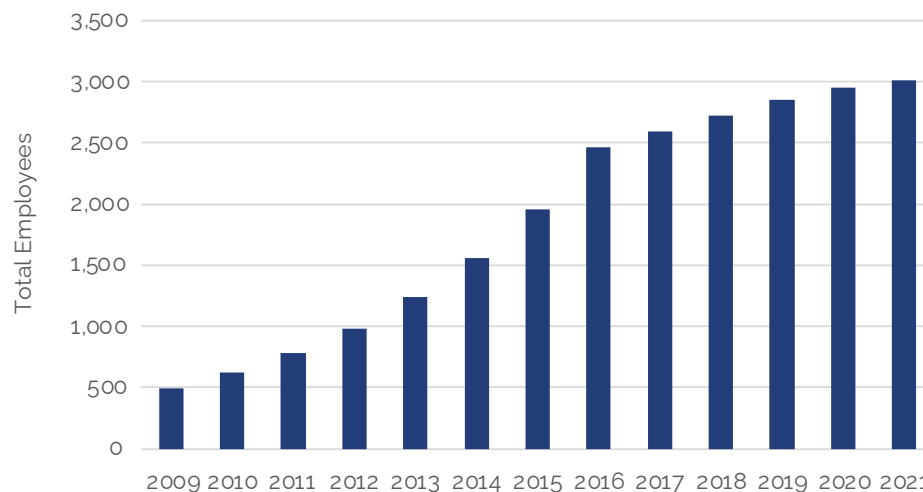
is 5 times higher in comparison to 2009! This was a good sign, especially in the situation of growing general unemployment where every position is important.

In 2021, total workforce of 6 leading companies in the Software export sector was 3,006 employees. We can see two trends: high growth (25% year-on-year) in period 2009-2016. And a slowdown (4.6% y-on-y) in period 2016-2020.

Table 20. *Workforce of Top Software exporters 2009-2021*

	Company	Domestic Ownership	2009	2016	2021
1	SCHNEIDER ELECTRIC DMS NS	N	142	895	991
2	LEVI 9	N	102	314	626
3	ENDAVA	N	70	356	513
4	RT-RK	Y	51	561	378
5	IGT (ex: GTECH)	N	129	215	326
6	NORDEUS	N	-	126	172
	TOTAL		494	2,467	3,006

Source: SITO, 2022

Figure 24. *Workforce growth of leading software exporters 2009-2021*

Total employment of the software sector, which is software export for the most part, has the increasing trend of more than 5,000 new employees per year, so most of IT graduates in Serbia find work soon after graduation. However, the lack of high-quality IT experts for development, programming, designing, and web design is already noticeable. It is estimated that the software sector will attract majority of IT experts of highest quality in the country for a longer period,

thus increasing its competitiveness and significance in entire Serbian IT industry.

3.2.3. Outsourcing sector – trends and potentials

Outsourcing continues to be the dominant business model in Serbian IT industry. However, adding value through

specialization (that we wrote about last time) has really picked up with Serbian IT businesses, who understood (correctly) that global marketplace does not simply grow – but the demand for high quality services, dedication, and narrow expertise are growing even faster.

Serbian Outsourcing sector is quickly evolving toward Custom Software Development, which brings specialization in market niche/technology/clientele/verticals.

Serbian companies adopt this strategy more and more, differentiating themselves on demanding global markets, adding significant value to their performance and gaining trust of ever more demanding clientele.

In recent years, Serbia embarked on the Research & Innovation Smart Specialization Strategy (RIS3) development journey. Supported and controlled by European Commission, the process of RIS3 development in countries outside EU was

initiated with the aim of bringing benefits of focused strategic documents compiled through a bottom-up approach to other economies, Western Balkan countries included. This approach involved a different way of engaging individuals and organizations tied to the ICT landscape in Serbia and produced one of the best SWOT analyses of the sector. Being one of the four identified priority sectors for RIS3 in Serbia, Information and Communication Technologies thread was led by Vojvodina ICT Cluster, as a prominent sectorial non-government institution with a lot of credit within Serbian ICT community and among businesses.

During this process, two priorities were identified within the ICT sector in Serbia as the main drivers for future growth: Custom Software Development and Sophisticated ICT Solutions Made in Serbia.

Obviously, it is about business models and the long-existing discussion about pros and cons for both. The Entrepreneurial Discovery Process⁷ spawned better understanding of the

⁷ The entrepreneurial discovery process (EDP) is widely conceived as an inclusive, evidence-based process of stakeholder engagement that produces information about the potential for new activities, thus enabling effective targeting of research and innovation policy.

basic business models in ICT and uncovered importance of both for future development. Different growth factors of these models give them different (dis)advantages, but the consensus was reached that the sector needs both.

However, general practice outsourcing where a shop of any size can answer any client request – does not compute anymore and the edge of competitive pricing has been gradually lost in the flood of raising standards. The RIS3 discussions confirmed that outsourcing model must evolve toward specialization. This specialization can be in terms of technology, market niche, economy verticals, or any other (or more than one) areas, which adds value for the client. Another side effect of this approach is elimination of middleman, making direct contact and work with end customer more desirable setup.

Several world-class examples of best practice facilitate promotion and visibility of Serbian IT sector. Companies like Schneider Electric DMS NS or RT-RK, successfully merged new technologies and innovation and employ thousands of people in their research and development centers. Examples like these are not many, which is why

their experiences are precious both as best practice examples for the Government when developing policies and for further development of the IT industry.

Serbian IT companies still lack the market intelligence about international markets: insufficient specific knowledge as to what the potential markets for their goods and services could be and how to access these markets. Luckily, global demand continued to rise and coupled with excellent performance of Serbian companies, made room for continual growth.

Our assumption from the previous report, that taking improved access to capital and IT experts would help outsourcing remain one of the main moving forces for delivery of services to local and foreign clients – is proving to be a correct one.

If decisive action on the part of the Serbian Government brings about domestic IT market revival, outsourcing of IT services will continue growth in Serbia for existing IT service companies, but also create an opportunity for startups to get involved. That is where the connection of

domestic IT market development to the development of Entrepreneurship Support System is most visible.

For the time being, Serbian IT outsources continue to do business mainly outside of Serbia and continue to use the same models of market penetration:

- Landing a contract through Serbian diaspora – word of mouth and using connections of colleagues working abroad.
- Landing a contract at B2B events organized by the Government, clusters, international development agencies and alike. All of them recognize Serbian ICT as a sector with high export potentials.
- Landing a contract through contacts created at international fairs. Usually, companies start with smaller values of initial contracts and thereafter develop trust and grow their cooperation into more serious contracts.

Threats to Future Development

Insufficient number of senior developers leads to disturbances in the labor market and causes large fluctuations. Experienced programmers, project leaders, and senior software architects

are the key resources for future accelerated software export sector in Serbia. For years now, there are no available (unemployed) experts of this kind in Serbia. Bigger salary is the main reason for changing companies and loyalty to any company has been in constant fall over the years. Retention rate fell to 3 to 4 years and, although it is higher than an average in global IT industries, this trend makes additional burden on companies' ability to maintain high quality of service.

IT workforce also continues to move abroad. Economic migration is a global phenomenon, Serbia being one of the countries where this is especially pronounced. Diaspora remittances can be observed as an illustration of this trend. Official statistics does not follow economic migrations, but based on diaspora remittances, the National Bank of Serbia records an annual average of €4 billion. This is more than 10% of Serbian GDP and, viewed globally, makes for one of the largest GDP percentages. Such an amount of money can be sent only by a very large number of people.

A potential fall of ICT demand in case of yet another global crisis is another threat. The experience from the

global crisis in 2009, but also the latest global markets disturbances, show that the crisis of big global IT players is not the opportunity for Serbia. When a crisis hits, states or large IT companies turn to their own resources, while the Serbian economy remains without investments, there is decreased demand and the best workforce which gets taken away by foreign companies. At the time of publishing this report, many Serbian IT companies feel the pressure as the winter is coming – employment rates are decreasing, reserves are being prepared.

In times of crisis, foreign-owned companies easily leave the Serbian market. In recent years, we have had examples of some very successful foreign IT companies leaving Serbia literally overnight, taking selected employees with them. Therefore, it is necessary to change the policy of the Government and strive to stimulate and improve support for the domestic IT industry, including the commitment to entrust domestic IT companies with large state procurements. References and experiences from these local projects would also contribute to increasing the export of domestic software solutions. This is the point at

which the €3 billion of IT exports in 2033 mentioned above would become more certain and sustainable in the long run.

3.2.4. The role of clusters in the sector's development

It is high time that the Government sits with IT clusters and work out a better way to utilize these associations in efforts to push ICT sector development further. Clusters are ideal platforms for connecting real-life business information output to policy makers and involving academic sector in the process. Recognition of clusters as important factors in any sector development is long overdue in Serbia. For example, clusters in EU went through transformation from triple-helix platforms for cooperation some ten years ago, to creator of new value chains through innovation in recent years. Throughout this transformation, clusters were recipients of lavish financial assistance and institutional support.

This road still needs to be paved in Serbia. Serbian clusters, especially those from IT industry, have started various initiatives toward the Government in efforts to

raise the cooperation to the higher level, with limited success. There were different initiatives where IT clusters took part: regulatory changes, development of strategic documents, and public discussions. However, much more could be done if a formal structure of this collaboration is established, and a reliable results-based funding scheme is established.

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



4

ENTREPRENEURSHIP SUPPORT ECOSYSTEM

Entrepreneurship in Serbia has entered a new chapter in the past two years, especially when it comes to tech entrepreneurship. The year 2021 was the most successful in terms of attracting venture capital and overall investments in Serbia-based startups.

The government stepped up and introduced a brand-new Strategy of Startup Ecosystem Development, followed by Action Plan 2021-2025. Also, the Law on Alternative Sources of Financing was introduced and new tax incentives for startup businesses. Such institutional support is more than welcome and is bound to produce results in coming years.

Rather than elaborating on many developments in the startup environment in Serbia, we bring your attention to an excellent publication, Startup Scanner 2022, published by Digital Serbia Initiative.

The Startup Scanner is a comprehensive report on the state of the domestic startup ecosystem, which will enable us to better understand the characteristics and opportunities in the domestic ecosystem and provide useful information to anyone interested in startups and those who can contribute to their development — from corporations, public sector, and international institutions to the entrepreneurs themselves.



5

DEVELOPMENT OF SERBIAN INFORMATION SOCIETY

5.1. INTRODUCTION: ANALOGUE AND DIGITAL SERBIA

Digital dividend for all

Digital technologies are strongly transforming business, work, and service delivery. Technological progress makes leading economies and societies more productive, while underdeveloped and developing countries still expect only the basic benefits of the digital revolution. On the one hand, there is a desire for a digital dividend for all, on the

other hand, the global digital divide is growing at all levels. In such an environment, Serbia and similar countries will face the challenges of a deeper digital divide and further lagging behind in the next decade. The question is: is it possible to catch up? Visible progress requires more than just technology, it is necessary to improve analogue areas that affect the efficient use of new digital tools by people and governments.

In essence, the best DIGITAL perspective in Serbia has individuals with specific IT knowledge. Entrepreneurs

and businesses with concrete and sustainable business ideas follow and the state itself has the weakest position because, within government, individuals with enthusiasm are not enough for serious changes. Digital progress in public administration will remain a challenging task until the government takes full advantage of the modernization and transparency opportunities offered by new technologies. Until then, Serbia will be an environment with few good opportunities, in which individuals and companies maintain their market focus on developed western countries and the opportunities they offer.

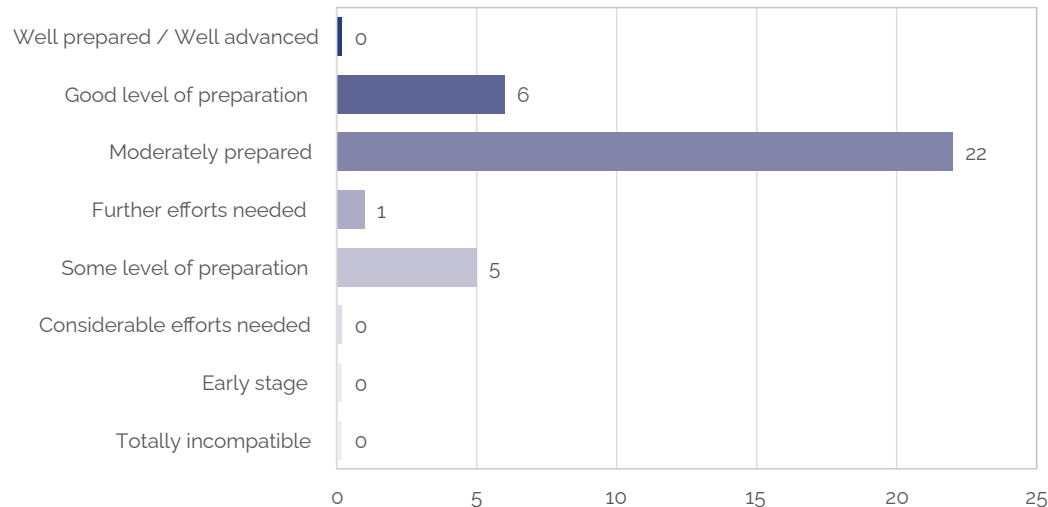
The analogue component of reforms in Serbia

A comprehensive rating of the state of affairs in Serbian society can be best perceived through the prism of EU accession negotiation process⁸. Reforms in 35 areas and negotiation chapters determine direction for Serbia, while regular annual assessments of European Commission point to the speed of the reforms.

Serbia is in the process of open negotiation about accession to the EU since 2014. Serbian Government initially hoped for conclusion of the process by 2020. It is obvious now that the second half of this decade seems to be an optimistic prognosis. There is an impression that nobody is in a hurry, Serbian Government has no capacity to speed up essential reforms, while European Commission does not show enough support. There is an impression that EU has pushed Serbian accession aside, while key issues of EU reorganization and future are being dealt with. Negotiation with Serbia has not been put to a halt formally, but a slower pace is evident and indicates there are essential challenges and a silent blockade. This should be an alarm and a call to action toward faster resolution of issues and problems in the negotiation process.

For Serbia and its comprehensive recovery, it is important to speed up meeting criteria and achieving EU standards. Figure xxx shows current status of 34 negotiation chapters, where the vertical axis is showing a scale with eight marks,

⁸ Commission Staff Working Document - Serbia 2021 Report

Figure 25. *Latest EC Assessment, Chapter and Acquis Status as of October 2022*

out of which only two (in green) are transitional grades for the EU.

The following figure remains unchanged since May 2019, and that is the best illustration of progress in EU-Serbia negotiations.

Key observations for this figure:

For six chapters, Serbia has “Good level of preparation⁹” mark, which is the second highest mark on the scale. Not to be misleading for readers, this mark is the lowest possible positive mark denoting such a level of achieved EU standards when a chapter can be closed. Therefore, any

⁹ Accession of Serbia to the European Union, https://en.wikipedia.org/wiki/Accession_of_Serbia_to_the_European_Union

mark below “Good level of preparation” is not transitional and requires further work on raising preparedness. For 22 chapters, current mark is “Moderately prepared” and requires one more step and a higher mark. Considerably stronger effort needs to be invested in additional 5 chapters that are marked with “Some level of preparation”. Silver lining is that, although the scale has three lower marks, Serbia did not receive them in any of the negotiation chapters.

Total number of 28 chapters that require better marks indicate that Serbia has considerable reform potential, which requires increased human capacities to speed up transition toward the EU. There is much more to do when it comes to changing the role of government, pervasive values in our society, and development of EU-shaped capitalism. Weak economy is equally painful topic for Serbia. Economic recovery requires continual GDP growth of above 5% all the way to 2030. To achieve that, Serbia has no choice but to modernize its economy. The only logical course of action is digital transformation and smart (strategic) investments in ICT – across sectors.

Consolidated analogue and digital reform

The state has powerful levers at its disposal to positively influence digital development. For starters, it is necessary to denote a competent jurisdiction (i.e., the ministry) which would unite ICT topics at the level of central government. Further, connections need to be created between ICT, technological progress, innovation, and patents. It is necessary to increase investments in research and development, especially investments in high tech. It is important to promote high tech sector and redefine incentives for increased investments in it.

What should countries do to mitigate risks of digital divide?

Connectivity is vital, but not enough to achieve the full development benefits. Digital investments need the support of analogue complements:

- **REGULATION** – so that firms can leverage the Internet to compete and innovate.
- **IMPROVED SKILLS** – so that people can take full advantage of digital opportunities.

- **ACCOUNTABLE INSTITUTIONS** – good governance of state institutions, in order to respond to citizens' needs and demands.

Digital technologies can, in turn, augment and strengthen these complements — accelerating the pace of development.

Numerous tasks lie in front of the Government, one of the most important being education of IT experts. It is good to see moves of the government to this end. Human resources are basic asset and the main moving force of the overall IT development, and the state is founder and chief financier of almost all institutions for higher ICT education. That is why considerable investments in this area have to be a priority. At the same time, decisive measures for cutting brain drain must be devised and implemented. Current situation is opposite of what we would like to have. There is a strong brain drain nowadays, often hidden by the fact that some IT experts still sit in Serbia – but still working elsewhere.

The factors above fall into a group of so-called analogue complements that are needed in doing contemporary

digital business. In all countries where analogue factors were set properly, digital technologies are in function of accelerated economic and societal development. On the contrary, countries with open analogue challenges should not succumb to deception that the exit is in new, modern – digital world. On their own, digital technologies are not a magic wand for progress of a country or a society. Just as a marathon runner needs both healthy legs to reach the finish line, replying equally on left and right one, contemporary society running a marathon toward a better version of itself need both analogue and digital backing. In the current phase of its development, Serbia must follow the path of reforms that includes two components – analogue and digital. Both are equally important.

If we were to be limited to one recommendation only, it would be to establish a detailed statistical overview of ICT at the state level, with periodical publishing of key indicators. This is a precondition to determine:

- The level of technological development
- Research and development potential
- A clear strategy of IT industry development

Monitoring and analysis of the state of ICT infrastructure, usage, and influence of ICT on the economy and society, opens the opportunity to utilize huge tech (sleeping) potential that definitely exists in Serbia. The stakes are high, as digital revolution mercilessly leaves behind countries that neglect the necessity of implementing reforms. Societies that embrace reforms, investments in technologies will bring an armful of digital dividends – benefiting individuals, businesses, and society at large.

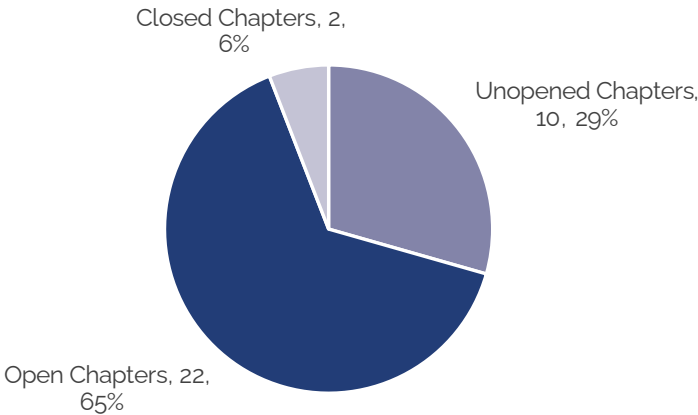
Negotiation progress

Key observations:

The current status of 35 negotiation chapters is as follows: 22 chapters opened, 2 chapters closed, 10 chapters still unopened, while negotiations are not required in one chapter (mark “Nothing to Adopt”). All in all, progress is evident, but only 6% of the total work has been completed, while the remaining 94% (32 chapters) is in different phases of progress.

The Serbian government continued declaring EU membership as a strategic goal. Ahead of the inter-governmental

Figure 26. *Negotiation progress: Chapter Status 2021.*



conference in June 2021, the government, in particular the Ministry for EU integration supported by line-Ministries, delivered on accession related documents very quickly. Serbia also restructured its EU negotiating team to reflect the revised enlargement methodology.

Still, sufficient human and financial resources on EU accession need to be in place across all institutions involved to match the renewed political focus by the government. In line with the EU accession objective, the Serbian authorities need to place

more emphasis on proactive and objective communication on the EU, which is Serbia's main political and economic partner.

5.2. REPORT ON INFORMATION SOCIETY DEVELOPMENT IN SERBIA

The European Commission has been monitoring Member States' digital progress through the Digital Economy and Society Index (DESI) reports since 2014. Each year, DESI includes country profiles which support Member States in identifying areas requiring priority action as well as thematic chapters offering a European-level analysis across key digital areas, essential for underpinning policy decisions.

The DESI 2021 reports are based mainly on 2020 data and present the state of the digital economy and society in the first year of the pandemic. DESI 2021 has been adjusted to reflect the two major policy initiatives set to have an impact on the digital transformation in the EU in the coming years: the Recovery and Resilience Facility (RRF) and the Digital Decade Compass.

Digital Economy and Society Index (DESI) 2021

Digital Economy and Society Index – DESI¹⁰ is a complex index which sums relevant indicators of digital performance and follows the development of EU countries in digital

Table 21. *Digital Economy and Society Index comprises four categories*

1	Human Capital	Internet use, basic and advanced digital skills
2	Connectivity	Fixed broadband, mobile broadband, and prices
3	Integration of Digital Technology	Business digitization and e-commerce
4	Digital Public Services	eGovernment and eHealth

¹⁰ <https://digital-strategy.ec.europa.eu/en/policies/desi>

competitiveness. It offers insight in general performance of a country and makes possible for simple identification of areas in which it can be improved.

The European Commission follows digital advancement of member states since 2014 and publishes annual reports on digital economy and society indexes (DESI). Each year, the report shows country profiles, which is helpful to member states in identification of areas in need of priority actions and thematic chapters that offer analyses at the EU level in key areas of digital policy.

In 2021, the EC adapted new methodology of calculating DESI so it reflects to main political initiatives that will influence EU digital transformation in the coming years: (1) assistance for recovery and resilience, and (2) Digital Decade Compass.

To align DESI in four main points and with the goals within the Digital Compass and to improve methodology that would consider the latest technological and political

developments, the Commission made numerous changes in 2021 edition of DESI. The indicators in Digital Compass are structured around the main four areas now, replacing previous five-dimensional structure and eleven DESI 2021 indicators measure goals set in the Digital Compass. In future, DESI will be aligned even closer to Digital Compass, to ensure that these goals are discussed in periodical reports.

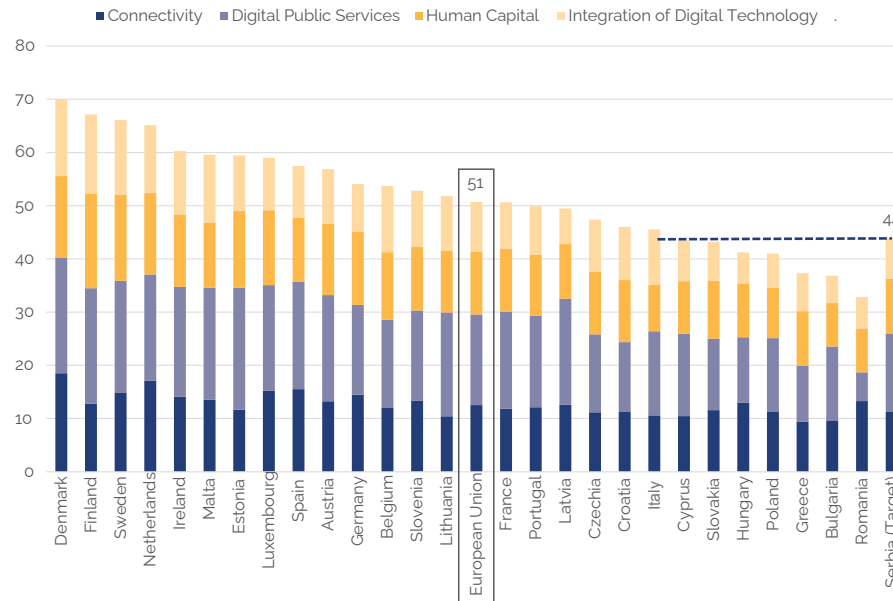
Furthermore, DESI now includes an indicator for level of support that adopted ICT technologies offer to companies in taking eco-friendly measures (ICT for eco sustainability) and using gigabit services – plus the percent of companies that offer training and use ICT e-invoicing.

DESI results and ranking from previous years were recalculated for all countries in order to reflect changes in choice of new indicators and corrections done in basic data.

Country Report Serbia

DESI for all European countries, including Serbia¹¹, is shown by categories, in the Figure below

Figure 27. *Digital Economy and Society Index, 2021*



Source for EU countries: <https://digital-agenda-data.eu/charts/desi-composite>, on 28-4-2022

Source for Serbia: RATEL

¹¹ NOTE: Serbian and EU countries' values are not completely comparable, because an overview of EU countries has been aligned with new methodology published in 2021 but is not fully applied in the Serbian index. In 2021, the EC adjusted DESI to reflect the two major policy initiatives that will have an impact on digital transformation in the EU over the coming years: the Recovery and Resilience Facility and the Digital Decade Compass.

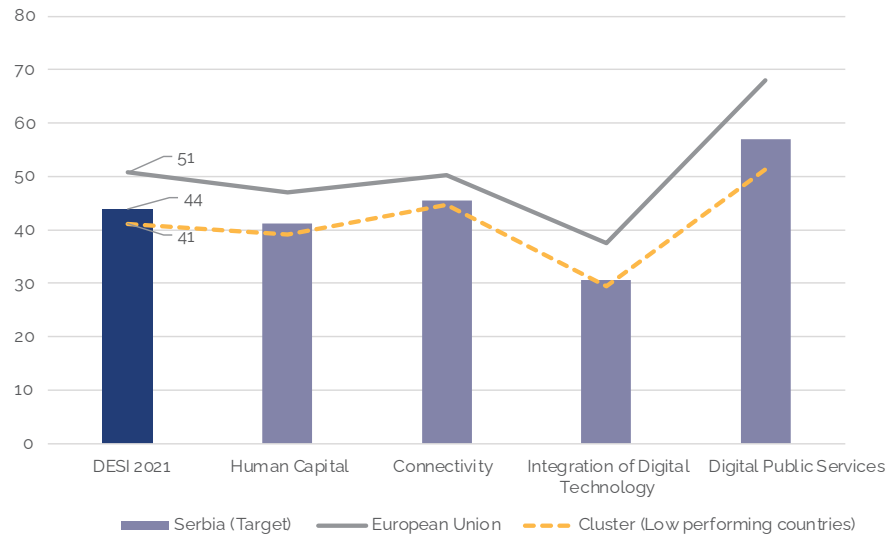
- The goal for Serbia is to be ranked 21st or better, in order to raise above the last quarter of countries, in front of 7 (25%) worst ranking EU member states. Such results would still put Serbia into the cluster of countries with relatively low performances: Romania, Bulgaria, Greece, Poland, Hungary, Slovakia, Cyprus, Italy, and Croatia. According to the value of target index (44), Serbia would be above the average of the clustered countries, but still notably below EU-27 average of 51.

The figure below shows average DESI values in individual categories. Results for Serbia, the cluster of comparable countries and EU-27 average are shown.

Key observations from the figure above:

- In category 1 – Human Capital, Serbia should record near average value (41) compared to the average in the cluster of comparable countries (39) and to reflect

Figure 28. Average DESI values and individual categories, 2021



acceleration toward EU-27 average (47). Note: As Serbia achieved better results in this segment than in previous years, we can assume that the real ranking of Serbia is even higher than the target in 2021. Serbia is expected to achieve high growth in this category in coming years, primarily through larger number of graduates from STEM disciplines.

- In category 2 – Connectivity, Serbia should aim to achieve the average level (45) of the cluster of comparable countries. In this category, Serbia was at the back of the list of European countries. The main reason was low percentage of Internet subscribers with at least 100 Mbps of only 0.9%. Optimism for a considerable growth of this index lays in the fact that infrastructure has been built and coverage of 67.4% of households with fixed broadband access of 100 Mbps or higher was achieved. Providers have done their part, now the ball is in the users' court.
- Serbian needs to maintain the average score (30) in the category 3 – Integration of Digital Technology in relation to the cluster of comparable countries. There is a lot of

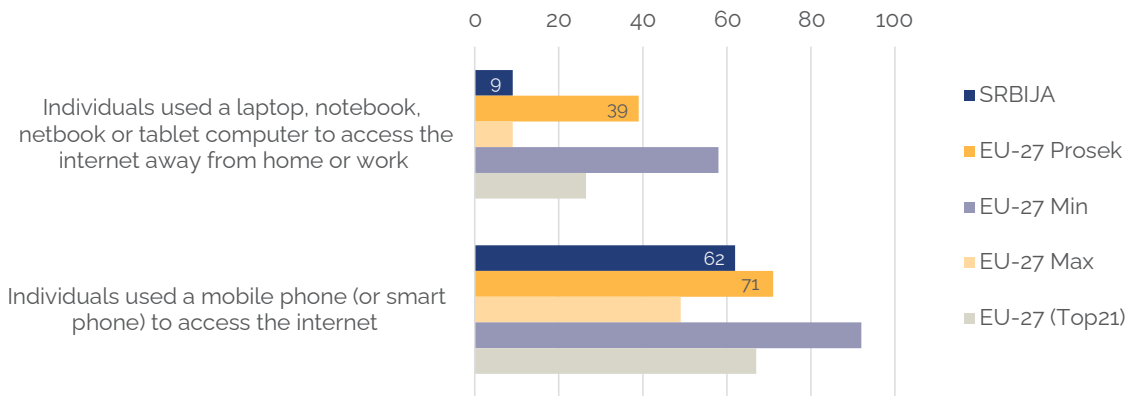
room for advancement in this category for Serbia, as well as throughout EU.

- According to the previous research, in category 4 – Digital Public Services, Serbia was the least successful compared to the EU countries in 2018. Target value in this category has now been set at 57, which is noticeably higher than the cluster of comparable countries (51), but at the same time considerably lower than the EU average (68). The reason for earlier lower rank should be found in low values of indicators for e-Government, showing the sophistication level of public services available on Internet, but also very low level of online medical services usage. Unlike all the rest of indicators in this category, where Serbia is below European average, results in the segment of open data access Serbia achieved EU average.

Connections to the Internet and computer usage

When looking at mobile access to the Internet, individuals in Serbia have a prominent role as content consumers and significantly smaller role of content creators. Usage of mobile phones to access the Internet is on a much higher level than usage of laptop computers.

Figure 29. *Individuals – mobile Internet access, EU, and Serbia 2020*



Source: EUROSTAT

Only 9% of individuals used a laptop, notebook, netbook, or tablet to access the Internet from home or work. That is far smaller percentage than the percentage of usage of these devices in population, which shows that mobility is mainly tied to the time between home and work.

It seems that this picture will stay with us for some time, until the percentage of those who use computers at work daily gets higher. Without sizeable business and profit, there is no

need for individuals to be online outside of office or home – mobile phones will suffice. Therefore, preconditions of more significant progress are technological modernization in business and increase of competitiveness.

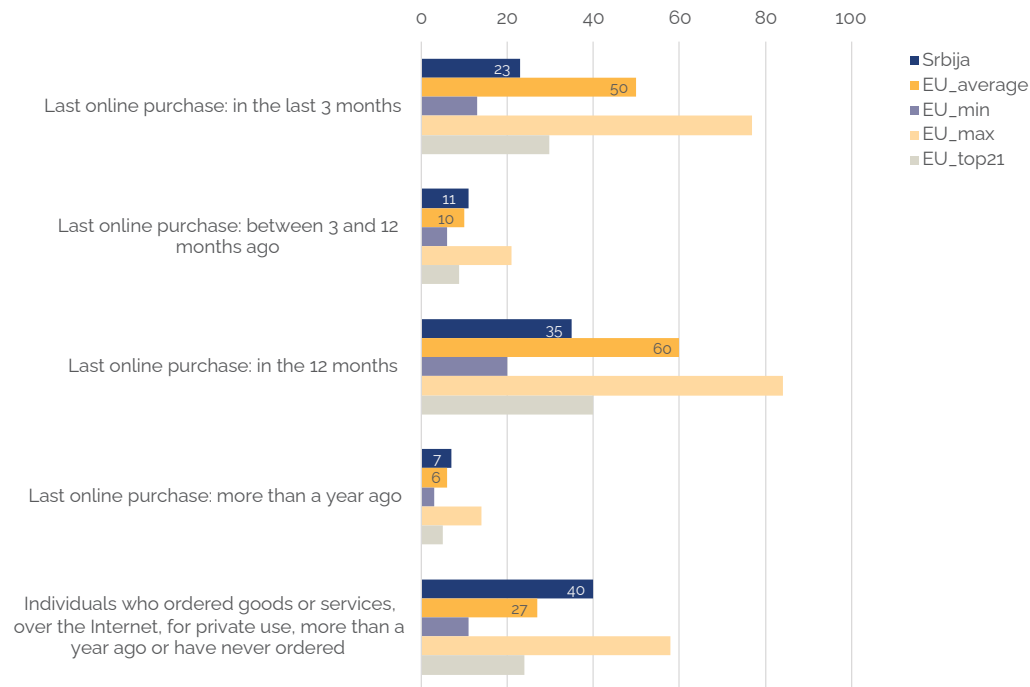
E-commerce and Internet purchases by individuals

There is a lot of room for advancement when we talk about e-commerce and online purchases in Serbia. Our country is

considerably below the EU average and somewhere in the middle when compared to the cluster of low-performing countries.

40% of individuals in Serbia have placed order online more than a year ago – or have never did so. That is substantially more than the EU average (27%). On the other hand, only 23% of individuals in Serbia have made an online purchase in the last 3 months, which is way below the EU average (50%).

Figure 30. *E-commerce and Internet purchases by individuals, EU, and Serbia 2020*



Source: EUROSTAT

E-Government

Citizens' access to e-Government services grows every year. However, the EU countries progress even faster, and Serbia keeps a low position, taking 25th place on an average in comparison with the EU countries. The table below shows detailed results for Serbia and the EU, by online activity.

29% Internet users in Serbia reported to being engaged in general interaction with public authorities and admin-

istration via the Internet. The EU countries average is 57%, while within the EU there is a wide range from 13% to 91%.

There is a distinct inequality of e-Government development and usage within the EU. On one hand, the leading countries reach 70% to 90% of e-Government services usage and on the other are countries that still only experiment with e-Government and only between 7% and 13% Internet users have online interaction with public administration.

Table 22. e-Government activities of individuals, 2020

	SERBIA [%]	EU-2018 [%]				SERBIA Rank of EU-28
		Avg	Min	Max	Top21	
Internet use: interaction with public authorities (last 12 months)	29	57	13	91	53	25
Internet use: obtaining information from public authorities web sites (last 12 months)	27	48	10	89	38	24
Internet use: downloading official forms (last 12 months)	20	35	8	75	29	
Internet use: submitting completed forms (last 12 months)	19	38	7	75	28	24

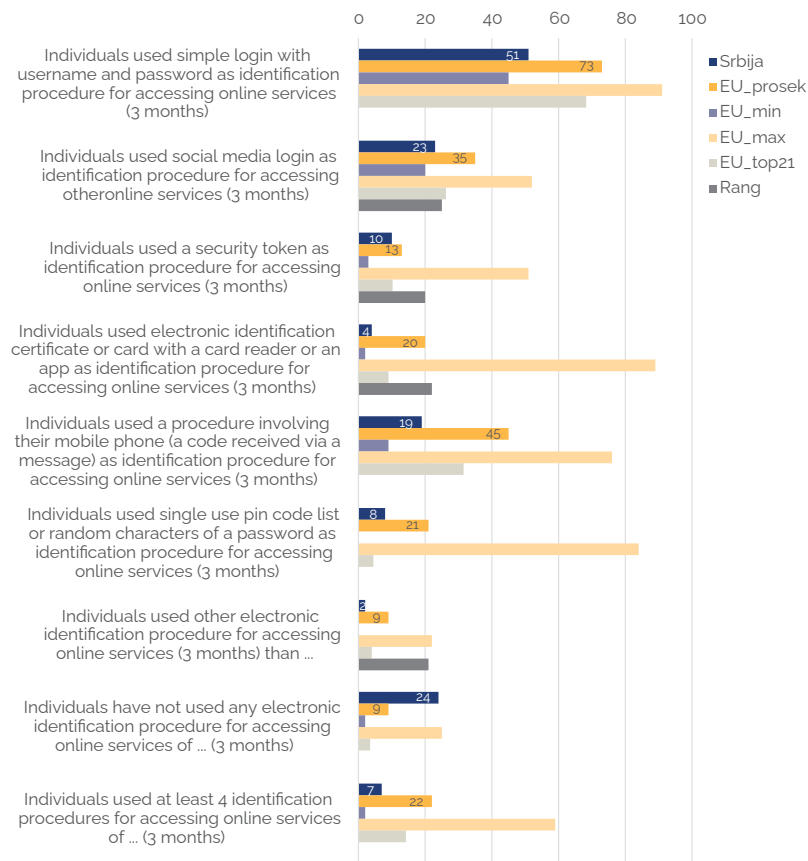
Source: EUROSTAT

ICT trust, security, and privacy

ICT trust, security and privacy are topics of crucial importance for the development of digital economy and society. Best practice and experiences from these areas are the basis for setting regulatory framework at the EU and national levels, in order to protect users, remove obstacles for development, and prevent influence of e-Business and e-Government flexibility. Such interdisciplinary approach in technology and legislation can generate real bureaucratic nightmare and clinical death of many Internet-based businesses. The challenge in the EU is regulation of the technology which is accelerated by the Internet and of the rights created and adopted by social consensus – where, sometimes, right is not the same as justice.

Only 51% of individuals in Serbia used simple login with username and password as identification procedure for online services, which is significantly below the EU average (73%), which ranks Serbia to 27th place among the EU countries.

Figure 31. Identification procedures used for online services, 2020



Source: EUROSTAT

More advanced identification procedures are present in Serbia only in traces: 2% to 8% – which ranks Serbia to the 26th position in an average, compared to the EU countries. There is a huge disproportion among the EU countries, where a small number of leading countries records high percentages of 70% and above, depending on the procedure. Most EU countries is in the early phase of development of identification procedures used for online services, which is visible in low average values in the figure above. Serbia has the opportunity to develop this practice on a par with numerous other EU countries that are at a similar level of development.

The Internet has a rule – Anything not forbidden is allowed. Therefore, a lot of irregularities was accumulated in virtual (digital) domain and regulated in the real (analogue) domain.

ICT users

This chapter aims to show the level of digital literacy of working age population. This is a very important topic, having in mind that digital skills are becoming one of the building blocks of national growth and competitiveness. The

Table 23. Levels of digital skills, 2020

	SERBIA	EU-2020				SERBIA ranking
		Average	Min	Max	Top21	
Individuals who have low overall digital skills	31	29	16	43	24	9
Individuals who have basic overall digital skills	26	25	18	36	20	
Individuals who have above basic overall digital skills	20	31	10	50	25	
Individuals who have basic or above basic overall digital skills	46	56	29	79	50	24

Source: EUROSTAT

table below shows results for the EU and Serbia, with the goal to make comparison and decide Serbia's position – as well as to discover reasons for potential gap toward the EU.

The result of 31% for Individuals who have low overall digital skills ranks Serbia among 10 worst ranking countries. Considering economic and political troubles of Serbia during the past three decades, this is not so bad, because the result is only 2% lower than the EU average.

On the other hand, 46% of Individuals in Serbia who have basic or above basic overall digital skills is considerably lower result than the EU average (56%) and puts Serbia at the 24th place, compared to the EU-28 countries.

There is correlation among levels of digital skills, levels of education, and type of business activity. Considering the fact that Serbia is facing high unemployment – which is affected by many factors, one of them having general level of education of the population at a lower level than the EU average – we could assume that Serbia is lagging in digital skills far more than the results shown above. The task of the

state is to identify and solve problems in the area of digital literacy, having in mind that these problems are shared with numerous EU members and that implementing best practices is an option.

Office for Information Technologies and e-Government

In July of 2017, the government established Office for Information Technologies and e-Government. Its mission is to support government in developing informatics infrastructure and digital public services. Those are mainly technical issues, while important topic of development and popularization of digital society among citizens, across the economy and public sector, remained under the jurisdiction of Sector for Information Society and Information Security of Ministry of Trade, Tourism, and Telecommunications. Split jurisdiction usually can slow down updating and introduction of necessary strategies and implementing action plans.

The Office carries out tasks related to:

- Designing, harmonizing, developing, and functioning of e-Government and information systems, as well

as infrastructure of state administration bodies and Government services;

- Development and implementation of standards when introducing information and communication technologies in state administration bodies and Government services, as well as support in the application of information and communication technologies in state administration bodies and Government services.
- Designing, developing, establishing, maintaining, and improving computer network of the national bodies; conducting operations for the needs of the Center for Security of ICT System in the national bodies (CERT of the national bodies).
- Providing services for designing, developing, and functioning of Internet access, Internet services and other centralized electronic services.
- Planning development and procurement of computer and communication equipment for the needs of state administration bodies and Government services, as well as other tasks determined by special regulations.

Ministry of Trade, Tourism, and Telecommunications (MTTT) – Jurisdiction

Jurisdiction of the Ministry in the area of telecommunications are, among others, electronic communication, and postal operations. The Ministry governs and takes care of security, determines strategies and policies of development, international relations, and introduces measures and incentives for research and development in the area of electronic communications.

Within the information society area, jurisdictions of the Ministry are:

- Proposing policies and strategies for development of information society.
- Preparation of laws and other regulations, standards, and measures in electronic business.
- Preparation of laws and other regulations, standards, and measures in the area of information society and information and communication technologies.
- Application of information and communication technologies.

- Development and functioning of information and communication infrastructure.
- Development and advancement of academic research and development computer network in education.
- Data protection and information security.
- International affairs in the area of information society.

5.3. CENTER FOR DIGITAL TRANSFORMATION – CDT

Origin

In response to the challenges posed by the global trend of digital transformation in the economy, the Chamber of Commerce and Industry of Serbia, with the support of the German development cooperation implemented by GIZ, established the Center for Digital Transformation (CDT). The company was formed with the intention of helping micro, small, and medium enterprises (MSMEs) in Serbia to meet the challenges posed by digital transformation.

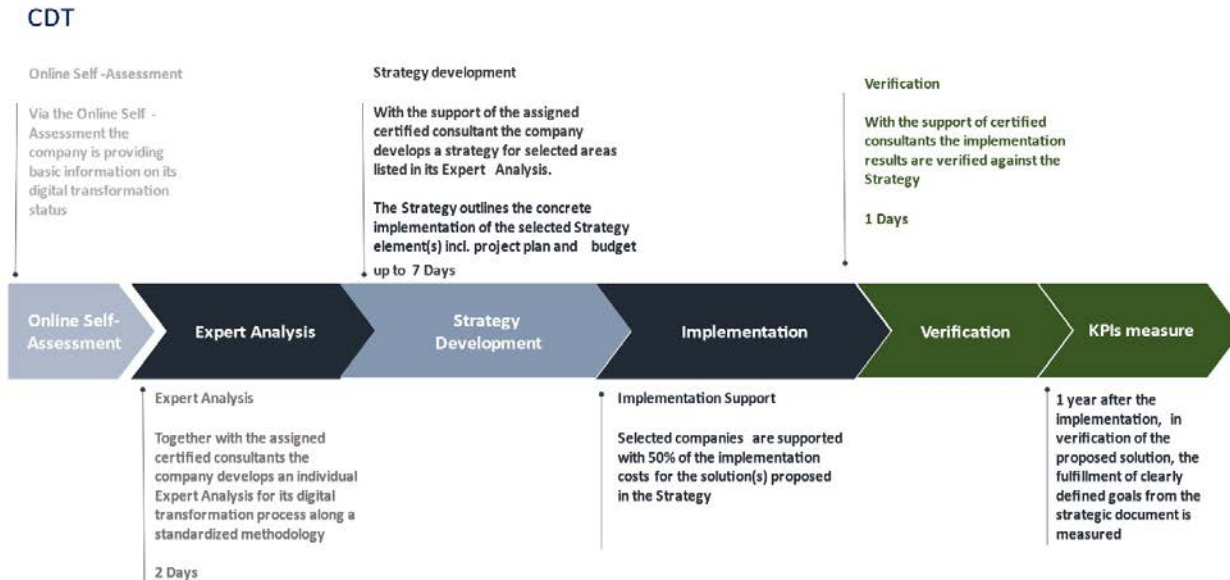
The increasing involvement of domestic companies in foreign supply chains would not be possible without

the use of modern IT tools. The most common problem recognized by CDT is precisely that companies do not know what digital transformation is, they do not know who to turn to for help, they consider it very expensive and some even hesitate to start the process themselves, they often make a mistake at the first step, so the implemented solutions, instead of being helpful, end up making the work and functioning of a company even more difficult.

CDT was founded with the very idea of spreading awareness of digital transformation, knowledge, and project co-financing to facilitate the path of companies that want to embark on the path to digital transformation.

Support programs for digital transformation

In four years of operation, over 1,500 companies from all branches of industry, varying in size from all over Serbia (92 cities) applied for CDT programs. A large part of them, with 68 certified consultants for digital transformation (ISO 17024), went the whole way from defining the necessary steps towards digital transformation to implementing those solutions.



Currently, the 2022 Digital Transformation Support Program is active, which offers strategic consulting support to companies from the MSME sector through a complex and advanced process that includes all elements: from the initial diagnosis of the problem to the determination of solutions, co-financing of solutions and monitoring their implementation. From May 2022, the CDT introduced the

1st Digital Transformation Support Program in the field of artificial intelligence with the right to a free subsidy. So far, over 50 MSMEs have already been registered, but the 2022 Program for AI plans to have 25 companies complete the implementation. CDT has trained 3 consultants in the field of AI, with the possibility of training more consultants depending on the demand for the program.

The biggest incentive for CDT to continue on the same and better path, towards an even greater number of companies to digitally transform, are the success stories received from companies that have gone through the programs and that have raised the level of their business using digital tools developed through CDT programs.

ERP, CRM and DMS systems, data protection, digital presence, are just some of the solutions most implemented by companies, which were developed through strategic documents made with CDT consultants.

Digital Academy and Knowledge Base

Integral elements of the website <https://cdt.org.rs/> and CDT activities include conceptualization, strategic design and implementation of the Knowledge Base and Digital Academy.

The knowledge base was conceptualized and developed as a portal intended primarily for certified consultants of the Center for Digital Transformation, but also for other partners of the Center who deal with digital transformation

in the broadest sense of the word and who are interested in sharing their content with professionals in this domain. The mentioned partners are mainly business associations, private companies that develop software for micro, small and medium enterprises, as well as academic individuals and institutions that are focused on this segment of the economy. In the Knowledge Base, all partners who are interested can find instruments, instructions, content related to the digital transformation of micro, small and medium-sized enterprises and which help professionals and that means primarily consultants, in their work. The database, by the way, has a hybrid structure and has a public part that is available to everyone and an exclusive part that is intended only for consultants and partners of the Center for Digital Transformation.

The Digital Academy was conceptualized and designed as a portal within the integral website of the Center for Digital Transformation, where the management of micro, small and medium enterprises could receive content in the form of short modules that would improve their knowledge, understanding and, of course, business. The modules were

conceptualized and classified into four groups and were designed on the basis of a thorough analysis of the referrals that companies filled out during previous application for the program. Based on those questionnaires, i.e., analysis of their content, a specific analysis of the needs of individual companies was made, so the modules that will be offered to them precisely correspond to their previously identified needs. After the lecture, participants will take online tests for the modules they have selected.

CDT plans

As a partner of the Ministry of Economy, CDT plans to expand its base of certified consultants from the existing 68 to 110 over the next 2 years, implement over 700 solutions in the MSME sector and work on intensive promotion of digital transformation both in Serbia and in the region.

There is a great interest from all countries in the region to apply CDT know-how on the implementation of the digital transformation program, which will definitely be implemented, and CDT Serbia will be established as a regional leader in this area.

5.4. THE ROLE OF GOVERNMENT

ICR is a dynamic field and requires from the Government constant work of improvement of regulatory framework and infrastructure. According to the EC report on advancement of Serbia in 2021, the Chapter 10 – Information Society states that the Council for Encouragement of Digital Economy, Innovation, Hi-Tech Entrepreneurship and Digitalization Development was established.

The Report continues with remarks that digital divide, especially with elderly and marginalized population, need to be dealt with.

Here we give a summary of activities and results of Government's work on digital in Serbia.

1. New Law on Digital Assets was introduced, which lays foundation for development of businesses based on digital assets and makes financing by digital token emission and local platforms for digital assets exchange possible. This legislation was followed by the Ministry of

Finance's guide on application of accounting standards to digital assets businesses. Also, by changes of tax laws, VAT is abolished for crypto currency trade and taxes on capital gain decreased by 50% if the profits from digital assets trade are invested into a Serbia-based company.

2. Incentives for investments in alternative investment funds were introduced

With new changes in tax laws, if an individual invests into AIF, i.e., venture capital fund, tax credit becomes available for all income up to 50% of the investment value.

3. Incentive for startup founders has been extended and prolonged

Taxes and contributions exemption for founders of innovative companies has been extended, with a bonus of not having to register in the Registry of Innovation Organizations.

4. The program Connected Schools is being implemented

This project makes possible for continuation of introduction of digital textbooks into schools, as well as proper equipment for computer classrooms. Jointly with support from the national budget and EIB loan, the total investment in digital infrastructure, training for teachers

and educational material in elementary and high schools is above €120 million.

5. The Action Plan for Industrial Policy Strategy has been adopted which needs to enable transformation of Serbian economy toward digitalization and innovation. Also, the **Action Plan for Smart Specialization Strategy** of Serbia has been adopted and ICT makes one of the 4S priority areas.

6. State Data Centre was opened and will be accessible to private users too. More info at <https://www.dct.rs/sr/>.

7. A new program of support to startups, StartTech, was created with the \$5million support from Philip Morris. Project implementation is being run by NALED and more info is available [here](#).

8. The project Raising Stars was initiated to support up to 100 startups with up to €15,000 each. Implementation is responsibility of the Science and Technology Park Belgrade. More info [here](#).

9. The series of free educational workshops has been held on using new tax incentives. The workshops were given by the tax consultants who have taken part in preparation of the incentives and all are

available online at [Serbia Creates YouTube channel](#). The brochures on support measures are available online in Serbian: <https://inovacije.srbijastvara.rs> and in English: <https://innovations.serbiacreates.rs>. Also, there is this [webinar on tax incentives](#) for research and development costs and IPR rights income – experiences after the first year of application, with interpretation by relevant government bodies.

10. After adopting the Law on Digital Assets, the Ministry of Finance published **Explainer on accounting confirmation, valuation and way of bookkeeping of digital assets in tax payers' books.**
11. A new package of tax incentives was introduced, where we especially single out **incentives for employees working on R&D projects, incentives for employment of (primarily) young and tax credit for annual taxation on income for young employees under the age of 40.** The changes were published in the Official Gazette No. 118, 9 December 2021.
12. The Serbian Government adopted The **Strategy for Start-up Ecosystem Development** and **Action Plan 2021-2022.**

13. The new **Law on Innovative Business** was adopted and in doing so it was reconciled with the Strategy for Start-up Ecosystem Development, with additional improvements.

14. The First **National Platform for AI development** was established within the State Data Centre, the foundation for which is a **latest generation supercomputer**, of high performances, with 5 petaflops density, made by NVIDIA. In the first phase, this platform was made available to faculties and science institutes, while opening access to startups is being planned.

15. Within the Institute for Molecular Genetics, The **Center for Genome Sequencing and Bioinformatics** was opened.

16. Construction of **BIO4 Campus** was initiated and a **conceptual solution was presented**, BIO4 Campus is in the hearth of efforts to make Serbia center of knowledge and creation of innovative solutions in the coming bio-revolution, where ICT is its integral part.

17. **TS Ventures Fund** was established, as the first official alternative investments fund in Serbia.

18. **Catapult** was initiated, which is the Innovation Fund's accelerator. Also **Serbia Ventures** program of the

Innovation Fund was established, with the task to create three new venture capital funds in Serbia.

19. **Science and Technology parks were open in Čačak and Niš** while the second phase was open in **Science and Technology Park in Novi Sad** was opened in the second phase. Also, a new building of the **Faculty of Organizational Sciences** has been opened.
20. A new **Directive on Criteria for Awarding Incentives to Companies Employing Foreigners who Settle Down in the Republic of Serbia** was adopted, with biggest gains expected for Serbian ICT sector.
21. The **National Council for e-Sport in the Republic of Serbia** was initiated, as well as **Entrepreneurship Portal** and **Start-up Portal** within it.
22. The **Centre for the 4th Industrial Revolution (C4IR)** has been initiated in partnership with World Economic Forum. In the focus of C4IR are AI and bioengineering.
23. A visit of **IT companies and startups delegation to Gitex Dubai** was organized, as a part of activities to present Serbia at Expo2020 in Dubai.
24. The **R&D Institute for Artificial Intelligence** was founded as a public service institution, in accordance with the

Strategy of AI Development 2020-2025. It is important for Serbia to align with EU policies on ethical usage of AI.

25. **Serbia is preparing for 5G frequency allocation and network introduction, announced for the end of 2021 initially.**

Conclusions

Let us remember that during the work on Serbian RIS3 document, the areas where the **role of government is both necessary and crucial** have been clearly defined:

- Education
- Business-enabling regulatory framework
- Domestic IT market development
- Boosting Entrepreneurship Support Ecosystem

It is worth noting that the government was proactive in aligning its role with these areas. There is plenty of work ahead, focus and acceleration of pace is needed.

Finally, in all our previous editions (and we repeat it here) we have stated that ICT jurisdictions in Serbia are diffused

among different ministries and government agencies. Once again, we put forward the initiative for establishment of one dedicated ministry that would collect these jurisdictions and bring more order and efficiency in governing ICT matters.

An important missing link that the Serbian Government should establish is a **structured cooperation and support to clusters**, especially in IT where these associations proved to be worthy counterparts in developing policies and valuable points of contact with the industry.

We still miss a dedicated ministry¹². And we repeat that establishment of such an office within the government is a missed opportunity. As we know, during the work on RIS3 document, couple of important steps were made. The vision and an excellent one at that, was adopted by the participants in the process and it reads: **"Serbia – source of sophisticated high-tech solutions and services for global markets"**. Contours of the plan to fulfil this vision

were given in the Policy Mix part of the RIS3 development process, where over fifty goals for the ICT were formulated and will serve as a guide for policy makers. Again, that is exactly where a dedicated ministry fits perfectly.

In the meantime, Serbian IT industry will continue to develop in its own bubble, preoccupied with **foreign markets, looming crisis, and a lack of workforce**. It will continue to grow and deliver **DIGITAL** products and solutions for clients in countries with strong **ANALOGUE** infrastructure.

The opportunity for Serbia to utilize its successful IT industry for overall progress is still there. If you are involved in ICT in Serbia, being a businessperson, academic, government official, or active in the civil sector – we need you to **get involved**. Give feedback, send a proposal, start an action, or join a cluster – because cooperation is the key.

¹² Readers are directed to the 2018 edition of this study, Section "Government ICT Policy", where continuity of discontinuity of ICT jurisdiction was elaborated.

5.5. NEW GOALS UNTIL 2025

Compared to numerous and complex indicators of success and advancement in IT, here we propose two simple and easily measurable goals: (1) money and (2) people. Following the dynamics of domestic IT market expressed in money demands regular periodical gathering of data and the number of employees in IT sector and number of IT experts comes down to simple counting once a year. The good side of this approach is simplicity and resilience to changes in a complex business environment. Following progress requires no special methodology nor its potential revisions.

What follows is a defined goal in terms of increase of IT investments and two goals connected to education and ICT workforce employment.

Money:

1.1. Increase in domestic IT investments up to the level of €1 billion, until 2025. The starting position in 2021 is €735 million.

People:

2.1. Increase the number of IT experts at high-education level by 15,000 until 2025.

2.2. Achieve the number of 70,000 employees in IT by 2025. Starting position in 2020: 41,000.

Increase of total IT investments of businesses and government to €1 billion annually in 2025

With the existing level of IT investments, only thing to be achieved is maintaining current level. New, increased IT investments until 2025, should advance situation in important areas and secure:

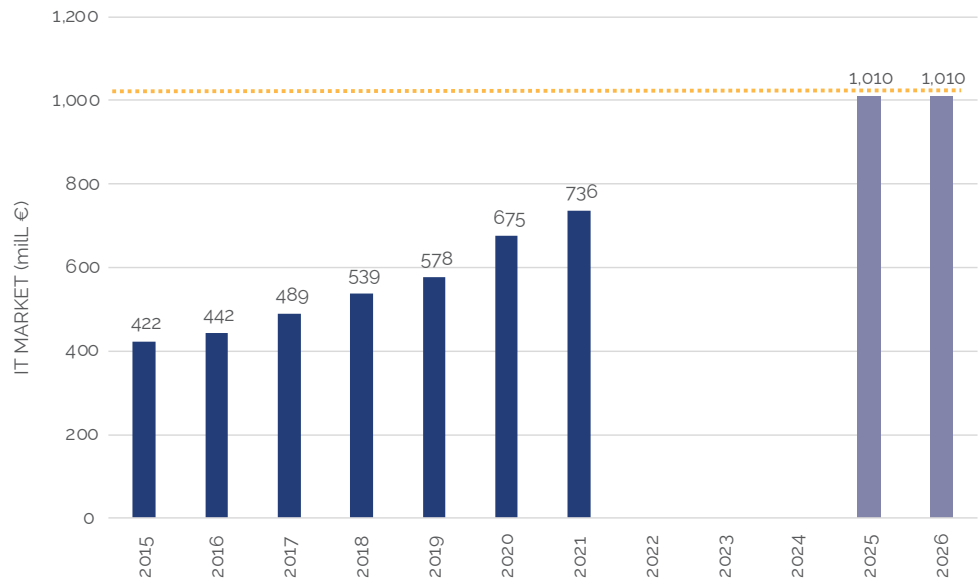
- Safe and efficient digital infrastructure
- Digital transformation of businesses
- Digitalization of public services

Serbia will remain in global digital divide while the total of IT investments is below 1.5% of the GDP. Serbian society and economy have a shot at accelerated recovery if IT investments reach 2% of GDP by 2025. At first, this seems

like easily achievable growth of “only” 0.5%. However, the same goal becomes more challenging if we translate it into the rate of IT investments per capita. Then, the current rate of €100 per capita needs to raise to €150. Therefore, to lessen the digital divide, Serbia needs the average annual growth rate of more than 10% until 2025.

Currently, domestic IT market is at a modest level, while planning its value of €1 billion means setting higher goals. Certainly, Serbian IT market has huge potential to grow. To release that potential, it is extremely important for Serbia **to accelerate EU association process and reforms that go with it** and are being implemented via 35 chapters. Additionally, we

Figure 32. *Trends and Potentials – New IT Goal for the Period 2022-2025*



Source: SITO, 2022

need **the next Government to keep IT a priority**. It is widely known by now that IT enters all other areas and it is hard to imagine functioning of a modern society without support of IT in education, healthcare, public and all other sectors. Similarly, IT is connected to several strategic documents related to information society, e-communication, science and research, and economic development.

If the Government accelerates reforms, its contribution to the growth of Serbian IT market will be crucial by 2025. Apart from raising awareness about the importance of increased IT investments with both policy makers and businesspeople, there is another precondition and that is **the average growth of GDP above 3%**. In challenging business environment and global political, healthcare and even economic, crisis – it is not completely certain that the Serbian economy will achieve such rate of growth.

IT workforce – education and employment

- Increase the number of IT experts with high education by 5 thousand per year and at least by 15 thousand until 2025.

- Increase employment in IT sector by 10 thousand annually and reach 70 thousand IT employees until 2025, with increased participation of women compared to the current situation (starting position in 2020: 41 thousand, 30% women).

IT experts are needed both in Serbia and globally. Employing IT experts for the needs of domestic market was in the background until now, IT services exporters stealing the spotlight. The task of digital transformation of the Serbian economy will not be a simple one as long as Serbian IT rides the wave of global demand for IT services without much interest for domestic underdeveloped market.

5.6. AN OVERVIEW OF IT PUBLICATIONS AND STRATEGIC DOCUMENTS

The EU perspective of Serbia determines the main direction of development in the area of strategic documents. The European Council granted Serbia the status of candidate country in 2012. The Stabilization and

Association Agreement (SAA) between Serbia and the EU entered into force in 2013. Meetings of the joint bodies under the agreement took place at regular intervals. Serbia continued to implement the SAA, although a number of compliance issues remain. Legislation and regulations have been improved in recent years. Since the opening of Serbia's accession negotiations in 2014, 16 out of 35 chapters have been opened, two of which were provisionally closed. The overall pace of negotiations will continue to depend on the intensity of reforms, particularly in the rule of law and in the normalization of relations with Kosovo*, as per the requirements of the Negotiating Framework.

Serbia is moderately prepared in the area of public administration reform. Some progress was made in the area of service delivery and with the adoption of several new laws in 2019. Influence of political parties in the process of appointing senior managers in state and budgetary institutions and public companies remains an issue of serious concern, especially regarding an excessive number of acting positions. Serbia's ability to attract and

retain qualified staff in the administration, especially dealing with the EU accession issues is crucial. The Government's practice of introducing majority of new laws via emergency procedures and without public debate or consultation with businesses, does not make it better.

Key national documents regarding ICT

This overview covers strategies and accompanying action plans which concern or are related to ICT in Serbia or have important points of connection to ICT. Considering that there are many documents with different level of influence and importance to ICT sector, we needed to select the most relevant ones for this analysis. All the documents here are processed according to the two criteria into the following types:

(Type 1) Type of a document

(Type 2) Area covered by a document

Each type is given appropriate level of influence – 1, 2, or 3 (the higher the number, the stronger the influence).

Strategies

Table 24. *The key national Strategies*

Id	Document title	Type 1	Type 2	Impact Level on ICT	Year
Current					
1	Smart Specialization Strategy of Serbia (4S) 2020-2027	2	3	① ② ③ ④ ⑤ ⑥ ⑦	2020
2	Strategy of Digital Skills Development 2019-2023	2	3	① ② ③ ④ ⑤ ⑥ ⑦	2020
3	Strategy of Artificial Intelligence 2020-2025	2	3	① ② ③ ④ ⑤ ⑥ ⑦	2019
4	Strategy of Development of Next Generation Networks until 2023	2	3	① ② ③ ④ ⑤ ⑥ ⑦	2018
5	Strategy for the Development of the Information Society and Information Security for the period 2021-2026	2	2	① ② ③ ④ ⑤ ⑥ ⑦	2021
6	Strategy for the Development of Start-up Ecosystems for the period 2021-2025	2	1	① ② ③ ④ ⑤ ⑥ ⑦	2021
7	Strategy of Industrial Policy 2021-2030	2	1	① ② ③ ④ ⑤ ⑥ ⑦	2020
8	Strategy of Scientific and Technological Development 2021-2025 – the Power of Knowledge	2	1	① ② ③ ④ ⑤ ⑥ ⑦	2021
9	Strategy of Fight Against High-Tech Crime 2019-2023	2	1	① ② ③ ④ ⑤ ⑥ ⑦	2018
Past					
1	Strategy of ICT Industry Development 2017-2020	2	4		2016
2	Strategy of Development and Support to the ICT industry	2	4		2013
3	Strategy of Broadband and Services Development until 2016	2	3		2014
4	Strategy of Information Society Development until 2020	2	2		2010
5	Strategy of Information Security Development 2017-2020	2	1		2017
4	Strategy of Scientific and Technological Development 2016-2020 – Research for Innovation	2	1		2016

Legend: Type 1 – Document type: (1) Law; (2) Strategy; (3) Action Plan.

Type 2 – Focus Area: (1) Other documents vertically connected to ICT; (2) Information Society; (3) Information and Communication technologies; (4) IT Industry

Action Plans

Table 25. *The key national Action Plans*

Id	Document title	Type 1	Type 2	Impact Level on ICT	Year
Current					
1	Action Plan for the period 2021-2022, for the Implementation of the Smart Specialization Strategy for the period 2020-2027	3	3	1 2 3 4 5 6 7	2021
3	Action Plan for the period 2020-2022, for the implementation of the Strategy for the Development of Artificial Intelligence for the period 2020-2025	3	3	1 2 3 4 5 6 7	2020
2	Action Plan for the period 2021-2023, for the Implementation of the Industrial Policy Strategy 2021-2030	3	1	1 2 3 4 5 6 7	2021
4	Proposal of the Program for Development of Electronic Government 2019-2022 and Action Plan for Implementation of the Program	3	1	1 2 3 4 5 6 7	2018
5	Action plan for the period until 31 December 2022 for the implementation of the Start-up Ecosystem Development Strategy for the period 2021-2025	3	1	1 2 3 4 5 6 7	2021
Past					
1	Action Plan for 2018, for implementation of the Strategy of ICT Industry Development 2017-2020	3	4		2017
2	Action Plan for the period 2018-2019, for Implementation of the Strategy of Information Society Development until 2020	3	2		2018
3	Action Plan for the period 2013-2014, for Implementation of the Strategy of Information Society Development until 2020	3	2		2012
4	Action Plan for Implementation of the Strategy of Scientific and Technological Development 2016-2020	3	1		2018
5	Action Plan for the period 2018-2019, for Implementation of the Strategy of Information Security 2017-2020	3	1		2017
6	Action Plan for the period 2015-2016, for Implementation of the Strategy for Development of Electronic Government 2015-2018	3	1		2015

Legend: Type 1 – Document type: (1) Law; (2) Strategy; (3) Action Plan.

Type 2 – Focus Area: (1) Other documents vertically connected to ICT; (2) Information Society; (3) Information and Communication technologies; (4) IT Industry.

For type of a document (Type 1), the following influence strengths were given:

- Law (level 1)
- Strategy (level 2)
- Action Plan (level 3).

For focus areas covered by a document (Type 2), the following levels were given:

- Other documents vertically connected to ICT (level 1)
- Information Society (level 2)
- Information and Communication Technologies (level 3)
- IT Industry (level 4)

The key national documents are presented in the table below, according to the assigned influence levels.

The reach of past strategies and a roadmap for new ones

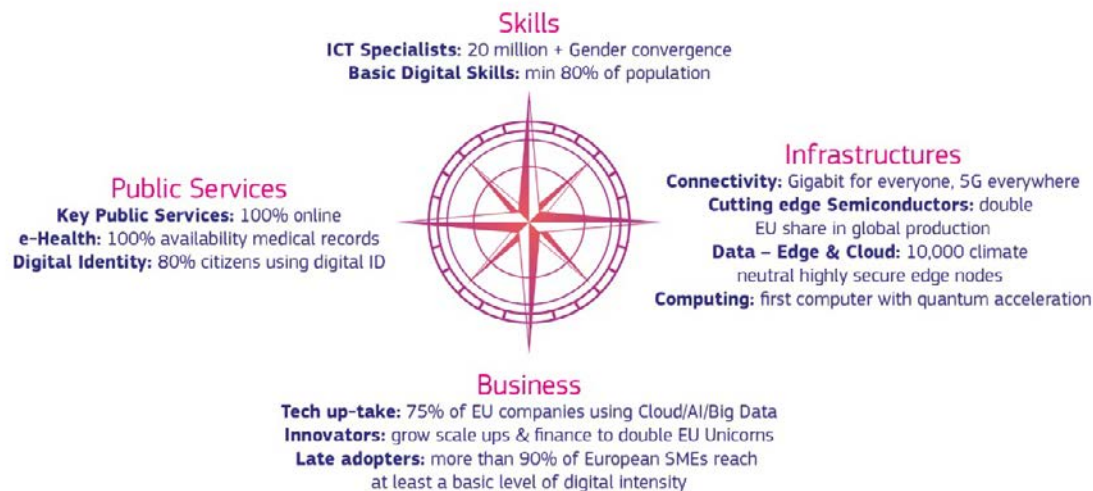
Since 2010, six strategies and accompanying action plans were adopted which covered a wider topic of information society in the period 2020 up to now and all are in the "Past" status (see the tables above). After (partial) implementation of activities that

were planned in strategies, some positive results are visible. However, these results are attributable primarily to the current technological development which happened spontaneously and affects the Serbian scene from global level. The global technological progress of previous decade was very powerful and strongly influenced situation in Serbia. On the other hand, there is a noticeable lack of local systemic follow-up on achieving action plans-defined goals and implementing activities. Those action plans also did not cover all goals set in strategic documents and only sporadically covered short periods within periods of validity of strategies.

Since 2021, we have a brand-new opportunity to correct such approach and improve the situation. Currently, we have a series of new strategies and action plans. The table above states nine strategies, of which six were adopted in the period 2020-2021. It would seem that the Government got involved ambitiously in planning and development of information society for the next five years. How to judge reach of current strategic documents and action plans? The most realistic expectation is that Serbia aligns plans with digital initiatives of European Commission, primarily

European Digital Compass until 2030,

The Communication '**Digital Compass: The European Way for the Digital Decade**' set out digital ambitions for the next decade in the form of clear, concrete targets (details in Annex 5.7.1).



The digital compass uses the 4 points of the compass to identify the main goals to reach over the next decade: a digitally skilled population and highly skilled digital professionals.

- secure and sustainable digital infrastructures.
- digital transformation of businesses.
- digitization of public services.

Key policy areas to ensure these goals are met include cloud computing, artificial intelligence, digital identities, data, and connectivity.

with Digital Compass 2030. This time, Serbia surely must invest more efforts in subsequent action plans for reaching goals and activities from strategies, especially those strategic documents that fall short of Digital Compass. The pages to follow contain comparative analysis of alignment of key goals from domestic strategies with the goals from the most important document **European Digital Compass until 2030**.

An overview of strategies in line with the European Digital Compass until 2030

The Strategy for the Development of the Information Society and Information Security for the period 2021-2026. The importance of information society development was recognized in the Republic of Serbia more than a decade ago when the first Information Society Development Strategy in the Republic of Serbia until 2020 was adopted ("Official Gazette of RS", No. 51/10), which covered all priority areas that contribute to the development of the information society, namely: electronic communications, e-government, e-health and e-justice, ICT in education,

science and culture, e-commerce, ICT business sector, information security.

Information security, which was included as a topic in the Information Society Development Strategy, has gained great importance in the previous period, since due to the use of new technologies, the risks that have arisen have grown and are still growing. Accordingly, in 2017, the Government adopted the Information Security Development Strategy for the period from 2017 to 2020 ("Official Gazette of RS", No. 53/17, hereinafter: the Information Security Development Strategy), which defined the principles of information security, priority areas and strategic goals related to the security of citizens, the economy, and the state. As these strategies expired in 2020, at the initiative of the Ministry of Trade, Tourism and Telecommunications, a Strategy for the period from 2021 to 2026 was drafted, which would include the field of information society and information security, in order to ensure continuity in their development and which would be adapted to the new circumstances resulting from the accelerated digitalization and development of new technologies in all segments of society.

• Vision and desired changes in line with the European Digital Compass by 2030. For the past decade, there have been adjustments to changes brought by application of ICT and focus on maximal utilization of advantages it presents. The goals of strategy implementation are:

1. Digitalized public administration that efficiently and in a transparent manner offers services to citizens and businesses
2. A raised level of digital skills of all citizens who can use ICT unhindered both in everyday life and in communication with public administration
3. Transformation of the economy through implementation of digitalization and support to application of IT toward modernization of business in all verticals
4. Secure information environment with satisfactory level of awareness about risks, but also of advantages that new technologies bring to citizens, public administration, and business

The first three goals are largely aligned with European Digital Compass by 2030.

The Smart Specialization Strategy for Serbia (4S) has been introduced in 2020. The authors of this Study were deeply involved in the process of the development of 4S, especially the part titled "Entrepreneurial Discovery Process" where extensive consultations with various stakeholders from quadruple helix were implemented for each of the four defined priority areas – the ICT being one of them.

An overall vision of the document places Serbia on the map as a source of smart and creative products and services, while the vision for the *ICT Priority Area* was defined as Serbia – **the source of high-tech solutions and services for the global market**. Apart from a solid analysis of R&I environment in Serbia, the Strategy lists a number of measures for achieving the goals defined – which sounds like a roadmap toward an action plan. Hopefully, we will see it in implementation very soon.

Work on development of Smart Specialization Strategy – 4S (RIS3) in Serbia, where ICT was identified as one of four priority domains, strongly supports focusing on

human capital development, support to entrepreneurship, and domestic ICT market development. Possible future indicators in these areas are number of experts entering the labor market, as well as number and value of startups. Desirable indicator – and probably with the widest coverage- could be investments in ICT per capita. We wrote about the latter in more details in our previous edition.

- **Vision and desired changes in line with the European Digital Compass by 2030.**
- Smart Specialization Strategy of Serbia 2020-2027 recognized two priority areas of ICT: (1) Custom Software Development, and (2) High-tech Products and Solutions Development
- Importance of these areas lays in the fact that those include application of big data and business analytics, cloud computing, IoT, embedded systems, AI, and blockchain technology. A special place is taken by ICT solutions that need to improve work of public administration and strategic decision-making processes. The Entrepreneurial Discovery Process pointed out the need for building capacities for education of ICT experts by using state of

the art technologies, as well as establishment of additional innovation and research business parks for companies and startups in ICT.

- This strategy is partially aligned with Business Target goal from European Digital Compass by 2030.

The Strategy for the Development of Digital Skills

Development of digital skills was defined through the Strategy of Digital Skills Development in the Republic of Serbia 2020-2024 and is being implemented through special goals:

1. Improvement of digital competencies within the education system
2. Improvement of basic and advanced digital skills for all citizens
3. Development of digital skills according to the labor market needs
4. Life-long learning for ICT experts

Digital skills imply possession of certain knowledge, skills, and behaviors in accordance to needs of individuals and

society in conditions of contemporary speedy development of ICT in the 21st century.

The vision and desired changes are aligned to European Digital Compass until 2030.

This is a national and strategic Government program that comprehensively organizes development of digital skills of population, with the goal of using potential of contemporary ICT, quality of life for all, better employment, work efficiency, and economic growth of the society.

An important precondition for development of information society and e-Government presents advancement of digital skills of all citizens, building capacities of public and private sector employees, for using new technologies and improvement of digital infrastructure in education institutions. Therefore, to achieve digital skills development goals, it is necessary to start with education system and provide all conditions for learning and acquiring additional competences. Accordingly, curricula need to be improved toward acquiring digital competences in pre-university education.

This strategy is largely aligned with Skills Target chapter in European Digital Compass by 2030".

Strategy for Artificial Intelligence 2020-2025 determines goals and measures for AI development and implementation of this document should result in economic growth, advancement of public services, advancement of scientific cadre and development of skills for jobs of the future. Also, implementation of measures from the Strategy should ensure safe way of AI development and application in Serbia, in accordance to internationally recognized ethical principles – in order to utilize the potentials of this technology toward advancement of quality of life for individuals and society at large, as well as achieving Sustainable Development Goals.

The Strategy has been aligned with the European AI Initiative, which established European Commission policy in the area of AI. In this context, Serbia as a candidate country, but also as a participant of the EU Framework Program for Research and Innovation, strives to secure all necessary alignment with the EU toward complete integration into European research and even closer cooperation.

- **Vision and desired changes in line with the European Digital Compass by 2030.**
- Strategy of AI Development in the Republic of Serbia 2020-2025 foresees, within the special goal titled Development of Economy Based on AI, implementation of measures that aim to successfully prepare businesses for new business models and market expectations, with distinct development of companies that base their business on application of AI.

This strategy is partially aligned with Business Target chapter from European Digital Compass by 2030.

Strategy of Development of Next Generation Networks until 2023 (2018) creates infrastructure preconditions for advancement in line with EU goals for digital single market. This Strategy promotes cloud computing, IoT, and 5G mobile systems development. It also recognizes synergies of numerous ICT sub-areas, for example of AI and IoT.

Digital economy growth of Serbia is stable for now and challenges for future growth can be found in the fact

that numerous state and business organizations work in isolation and independently of one another. A coherent approach is recommended for future digitalization, as well as more efficient coordination of all interested stakeholders – participants in the digitalization process. Additionally, responsible performance is required from all actors, especially good governance in the state institutions.

This strategy is partially aligned with Infrastructures (Connectivity) target from European Digital Compass by 2030.

Among other strategic documents which offer potential that their goals get aligned with Digital Compass targets, we select the following: (1) Strategy of Industrial Policy in the Republic of Serbia 2021-2030, and (2) Strategy of Start-up Ecosystem Development 2021-2025.

Strategy of Industrial Policy in the Republic of Serbia 2021-2030 defines special goal of Improvement of digitalization of business models of industrial production and through implementation of foreseen measures there

is tendency toward transformed industry of the Republic of Serbia that, along with other measures from this strategy, give strong support to economic growth and raising quality of life of citizens.

Strategy for the Development of Start-up Ecosystems for the period 2021-2025.

In order to strengthen the economic system of the Republic of Serbia, encouraging startup ecosystems is known as one of the priorities of the Government in the period from 2021 to 2025. The overall goal of this strategy is to accelerate the development of startup ecosystems to the ecosystem development phase of between 800 and 1,200 startups, which attracts a large number of talents, experienced founders, investors, and mentors from the region due to its attractiveness.

The specific objectives of the Strategy are:

- Raising startup entrepreneurial capacity through educational programs.
- Improving infrastructure and software support for startups.
- Improving the startup financing mechanism.
- Improving the conditions for starting a business.

- Promotion of startup culture and global ecosystem recognition.

We can conclude that development of ICT sector in accordance with the current strategic documents rests on several pillars:

1. Development of companies and products in the area of ICT
2. Digitalization of businesses in all economic verticals through usage of ICT
3. Development of economy based on application of AI
4. Development of digital skills for the needs of labor market and strengthening capacities of ICT experts.

Among other notable activities in the period 2020-2021, we recognize (1) action plan adoption for Smart Specialization Strategy of Serbia 2020-2027 and (2) action plan adoption for implementation of Strategy of Industrial Policy 2021-2030, aiming to improve digital skills and raise competitiveness of Serbian industry through improvement of digitalization of business models of industrial production.

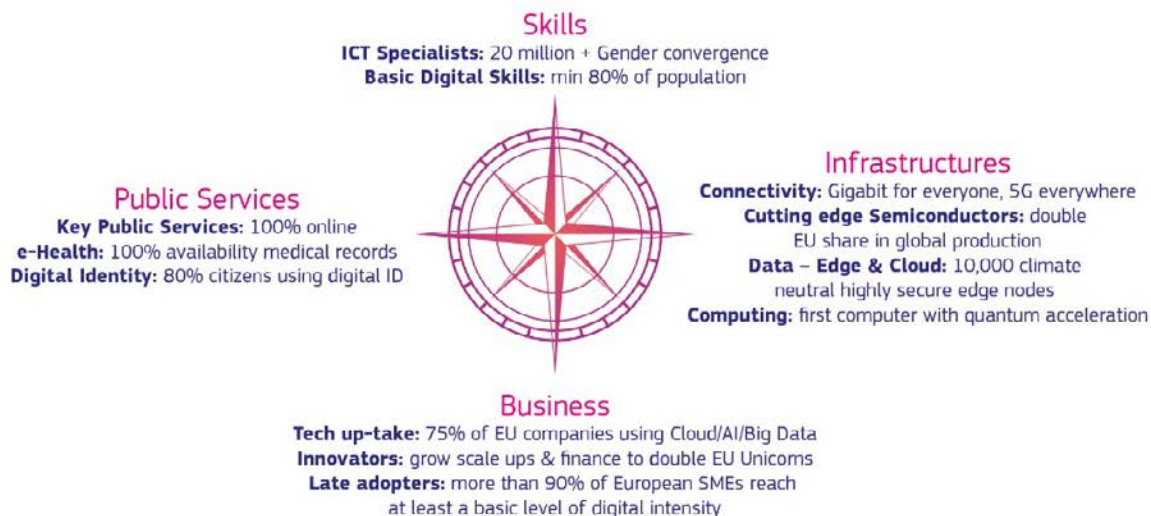
5.7. ANNEXES

5.7.1. 2030 Digital Compass:

The European way for the Digital Decade

The Commission proposes to set up a Digital Compass to translate the EU's digital ambitions for 2030 into concrete targets and to ensure that these objectives will

be met. The Compass will be based on an enhanced monitoring system ¹⁰, to follow the EU's trajectory regarding the pace of a digital transformation, gaps in European strategic digital capacities as well as the implementation of digital principles. It will include the means to deliver the vision and set out key milestones along four cardinal points. The first two are focused on digital capacities in infrastructures and education & skills, and the two others are focused on digital transformation of business and public services.



A digitally skilled population and highly skilled digital professionals

Digital skills will be essential to reinforce our collective resilience as a society. Basic digital skills for all citizens and the opportunity to acquire new specialized digital skills for the workforce are a prerequisite to participate actively in the Digital Decade, as explained in the European Skills Agenda [11](#).

Going towards 2030, the global competition for talent will be fierce, as expertise will remain scarce and be a critical factor of innovation, productivity growth and prosperity for all countries. The fostering of the EU's attractiveness as well as support schemes for digital talent will play a key role in EU's digital transformation.

It is our proposed level of ambition that by 2030:

- In addition to the target on basic digital skills established in the European Pillar of Social Rights Action Plan, there are 20 million employed ICT specialists in the EU, with convergence between women and men.

Secure and performant sustainable digital infrastructures

Excellent and secure connectivity for everybody and everywhere in Europe is a prerequisite for a society in which every business and citizen can fully participate. Achieving gigabit connectivity by 2030 is key. Although this ambition can be reached with any technology mix, the focus should be on the more sustainable next generation fixed, mobile and satellite connectivity, with Very High Capacity Networks including 5G being rolled out, based on swift and efficient allocation of spectrum and respect of the 5G cybersecurity toolbox [14](#) and with 6G being developed in the years to come [15](#).

It is our proposed level of ambition that by 2030

All European households will be covered by a Gigabit network, with all populated areas covered by 5G [16](#).

If connectivity is a precondition for digital transformation, microprocessors are at the start of most of the key, strategic value chains such as connected cars, phones, Internet of

Things, high performance computers, edge computers and Artificial Intelligence. While Europe designs and manufactures high-end chips, there are important gaps, notably in state-of-the-art fabrication technologies and in chip design, exposing Europe to a number of vulnerabilities. ¹⁷

It is our proposed level of ambition that by 2030

The production of cutting-edge and sustainable semiconductors in Europe including processors is at least 20% of world production in value (meaning manufacturing capacities below 5nm nodes aiming at 2nm and 10 times more energy efficient than today) ¹⁸.

Intelligent edge computing – applications:

- To monitor dangerous intersections for an autonomous vehicle.
- In “Smart Farming” where the deployment of edge capacity connected to machinery in farms will allow to collect agriculture data in real time.
- In Manufacturing-as-a-service enabling manufacturing companies – notably SMEs
- Health data and health records
- In public sector modernization

It is our proposed level of ambition that by 2030

- 10,000 climate neutral highly secure edge nodes are deployed in the EU, distributed in a way that will guarantee access to data services with low latency (few milliseconds) wherever businesses are located.

At the same time, the EU must invest in new quantum technologies. The EU should be at the global cutting edge of developing quantum computers which are fully programmable and accessible from everywhere in Europe while being highly energy efficient and which will be able to solve in hours what is currently solved in hundreds of days, if not years.

The Quantum revolution in the next decade will be a game changer in the emergence and use of digital technologies.

Examples of possible applications include:

- Health
- Increase security of communication and data transfers
- Better monitoring of resources
- Business/environment

It is our proposed level of ambition that

By 2025, Europe will have its first computer with quantum acceleration paving the way for Europe to be at the cutting edge of quantum capabilities by 2030.

Digital transformation of businesses

The transformation of businesses will depend on their ability to adopt new digital technologies rapidly and across the board, including in industrial and services ecosystems that are lagging behind. EU support, notably through the Single Market, Digital Europe, and Cohesion programs, will promote the deployment and use of digital capabilities including industrial data spaces, computing power, open standards, testing and experimentation facilities.

SMEs have a central role in this transition, not only because they represent the bulk of the EU companies, but also because they are a critical source of innovation [28](#). With the support of over 200 Digital Innovation Hubs and industrial clusters, by 2030, SMEs should have the opportunity to access digital technologies or data easily and on fair

terms, ensured by appropriate regulation and benefit from adequate support to digitalize.

It is our proposed level of ambition that by 2030:

- 75% of European enterprises have taken up cloud computing services, big data, and Artificial Intelligence
- More than 90% of European SMEs reach at least a basic level of digital intensity [29](#)
- Europe will grow the pipeline of its innovative scale ups and improve their access to finance, leading to doubling the number of unicorns [30](#) in Europe.

Digitalization of public services

By 2030, the EU's objective is to ensure that democratic life and public services online will be fully accessible for everyone, including persons with disabilities and benefit from a best-in-class digital environment providing for easy-to-use, efficient, and personalized services and tools with high security and privacy standards. Secured e-voting would encourage greater public participation on democratic life. User-friendly services will allow citizens of

all ages and businesses of all sizes to influence the direction and outcomes of government activities more efficiently and improve public services. Government as a Platform, as a new way of building digital public services, will provide a holistic and easy access to public services with a seamless interplay of advanced capabilities, such as data processing, AI, and virtual reality. It will also contribute to stimulating productivity gains by European business, thanks to more efficient services that are digital by default ³¹ as well as a role model incentivizing businesses, in particular SMEs, towards greater digitalization.

The digital transformation should also enable modern and efficient justice systems ³⁵, enforcement of consumer rights and an increased effectiveness of public action including

It is our proposed level of ambition that by 2030:

- 100% online provision of key public services available for European citizens and businesses
- 100% of European citizens have access to medical records (e-records)
- 80% of citizens will use a digital ID solution.

law enforcement and investigation capacities ³⁶ – what is illegal offline is also illegal online and law enforcement must be best equipped to deal with more and more sophisticated digital crimes.

5.7.2. Annex B: Analysis of existing, planned and needed ICT infrastructure

Future brings a network-based economy of knowledge, with the Internet at its core. To support it, Europe needs widespread, affordable, and fast (30Mbps) and ultrafast (over 100Mbps) Internet access. Fast networks infrastructure development has a revolutionary influence and presents one of the basic goals of the Digital Agenda for Europe.

The connectivity dimension of the Digital Economy and Society Index (DESI) looks at both the demand and the supply side of fixed and mobile broadband. Under fixed broadband, it assesses the take-up of overall and ultrafast broadband (at least 100 Mbps), the availability of fast broadband (next generation access (NGA) providing at

Table 26. *Connectivity indicators in Serbia and DESI*

Indicator Connectivity	Serbia 2020*	EU 2018	EU 2020
1a1 Overall fixed broadband take-up (% households)	69.6%	75%	78%
1a2 At least 100 Mbps fixed broadband take-up (% households)	18.8%	15%	26%
1b1 Fast broadband (NGA) coverage At least 30 Mbps (% households)	76.7%	79%	86%
1b2 Fixed Very High-Capacity Network (VHCN) coverage (% households)	49.2	26%	44%
1c1 4G coverage % Households (average of operators)	96.7%	91%	96%
1c2 Mobile broadband take-up Subscriptions per 100 people	95	90	100
1c3 5G readiness Assigned spectrum as a % of total harmonized 5G spectrum	NA	NA	21%
1d1 Broadband price index Score (0 to 100)	70.6	NA	64

Source: DESI 2020, European Commission and *RATEL for Serbian data

least 30 Mbps) and of fixed very high-capacity networks (VHCNs) and also considers the prices of retail offers. Mobile broadband includes 4G coverage, the take-up of

mobile broadband (3G and 4G) and the indicator on 5G readiness. Digital connectivity is considered a social right in the EU.

Additional observations from the table above:

- In the connectivity dimension, Serbia is positioned in the top 10 EU countries. Serbia has made significant progress in the last two years, which has affected the progress on the list of European countries in this category.
- In connectivity, Denmark had the highest score, followed by Sweden, Luxembourg, Latvia, and Spain. Greece, Cyprus, and Bulgaria had the weakest performance for this dimension of the DESI.
- As for the mobile broadband sub-dimension (including indicators 1c1, 1c2 and 1c3), Finland, Germany, Italy, Hungary, and Denmark lead Europe, while Bulgaria and Slovenia registered the lowest scores.

Internet providers have done their part, infrastructure has been built, but in large part it goes beyond current population's demand for high speed.

According to the goals of single digital agenda for Europe, Serbia should achieve total coverage of households with

fixed broadband access of at least 30 Mbps or reaching 100% compared to the current 76.7% of household coverage. Urban environments are already covered almost to the full, but rural areas are not. Further investments in infrastructure and penetration in rural areas present a challenge, as long as urban areas use less than half of existing capacities. The government has no instruments to motivate providers to invest further when previous investments have not start to generate revenues. Any cost of broadband presents a problem for the majority of citizens. Such a low usage threatens to continue longer, which points to deepening of digital gap both in geography and in purchase power. The way out of this stalemate is in accelerated economic development and raising standards of living. Without good economic results in this and the following year, Serbia is faced with a risk of further stunts in creating digital economy and society.



6

ICT EDUCATION AND HUMAN RESOURCE DEVELOPMENT

This chapter provides the following information:

- *An overview of ICT labor market in Serbia*
- *ICT and higher education in Serbia*
- *Workforce and Employment in ICT*
- *Representation of women in ICT study programs*
- *ICT and vocational trainings*

According to the Serbian Statistical Office (Chapter Education)¹³, in 2020, 96.6% of the pertinent population participated in primary education level, 87.4% in secondary, and 54.7% in tertiary education level. Public spending on education is comparable to that of EU countries, but outcomes in terms of skills and key competences are weaker. The worsening demographic

situation and weak education outcomes demand increased focus on human capital policies. Serbia's population is ageing and shrinking by around 0.5% per year. In 2020, the total number of students was 242,550, which is 3.6% less than five years before. At the same time, the number of graduates fell to 41,395 or 8.8% less than in 2016.

¹³ <https://data.stat.gov.rs/Home/Result/1109?languageCode=sr-Cyrl>

6.1. ICT AND HIGHER EDUCATION

In the 2020/2021 school year, 23,061 out of 242,550 students are in the ICT area in Serbia. Further 47,868 students are in the technical areas (engineering, manufacturing, and construction). The number of students associated with technical skills is rising year by year.

More than 19% of all Serbian newly enrolled students in 2020 were ICT enrollees (9,248), which is a clear indicator of interest of Serbian young people in studies related to informatics. The overall enrolment capacity of around 14,000 is bigger, because all studying programs are split into three level degrees.

Realistic estimate is that Serbia can count on around 4,000 ICT experts out of 5,188 ICT graduates in 2020, as the remaining number continued their studies towards the second and third level degree of education.

The quality, equality and relevance of education and training have to be improved in order to better match

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

6.1.1. An Overview

The tradition of training personnel in electrical engineering in Serbia is over one century long. The need for staff qualified in informatics was recognized in the 1980s within the Faculty of Electrical Engineering, Faculty of Mathematics, and Faculty of Organizational Sciences – all in Belgrade, Electronic Faculty – in Niš; Faculty of

Table 27. *Tertiary-type A and type B Education Programs in Serbia*

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

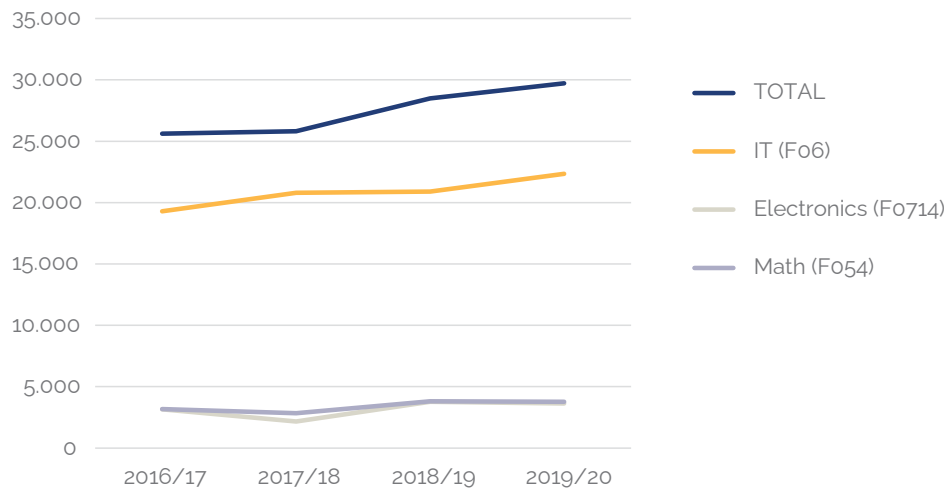
Technical Science, and Faculty of Sciences – in Novi Sad. With around 2,000 graduated IT experts annually, the above-mentioned institutions make the backbone of Serbian higher education (Tertiary-type A) in the IT area, as well as a base for research and development in this area. There is almost the same number of IT experts, graduating from other departments, with skills related to informatics. Tertiary type-A education is of strategic importance for ICT industry developing capacities.

The Serbian ICT sector absorbs the vast majority of ICT graduates. This has not always been the case, as Serbia

has been facing a massive “brain drain” of ICT graduates and professionals for years. Considering today’s growing demand for ICT products and services, which is a general trend not only in Serbia but throughout Europe, Serbian educational institutions face the challenge of attracting even more students and supplying more experts to the market.

ICT education exists at 53 higher education institutions distributed in 24 cities, which helps recruiting a wide base of ICT students.

Figure 33. *ICT Students enrolled in tertiary education by program orientation, 2016-2020*



Source: EUROSTAT, 2022

6.1.2. Number of ICT entrants

The table below shows the number of accredited entrants (freshmen) by study programs in the academic year of 2020/2021. The studies are divided into two study programs – undergraduate academic studies (OAS) and undergraduate vocational studies (OSS).

The total number of new ICT enrollees in school year 2020/2021 was 9,272 of whom 6,049 students begin their ICT education with tertiary type A studying program (OAS) and remaining 3,223 are with tertiary type B (OSS). In the period 2012-2020, an impressive growth (68%) of freshmen was registered. The average growth rate in the six-year period was 6.7%, whereas the number of students in OAS

Table 28. *Number of ICT freshmen enrolled in 2020/2021 academic year*

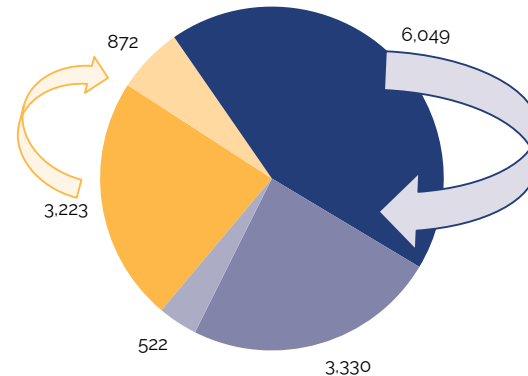
Program	Secondary school	Faculties	Total
OAS	30	6,019	6,049
OSS	3,033	190	3,223
Total	3,063	6,209	9,272

Source: SITO, 2022

programs grew by higher rate (10%) than the number of OSS students (5%).

The number of freshmen directly influences the number of future experts the sector could count on three to five years later. Less than 2/3 of enrolled students graduate, while a certain number of students get employed during the studies – which is the main reason the majority of those never graduates. We could say that whether they receive a diploma or not – significant number of IT students find jobs easy.

6.1.3. Distribution of ICT entrants by study programs

Figure 34. *Capacity of New Enrollees according to ICT Study Programs, in 2021/2022*

Source: SITO, 2022

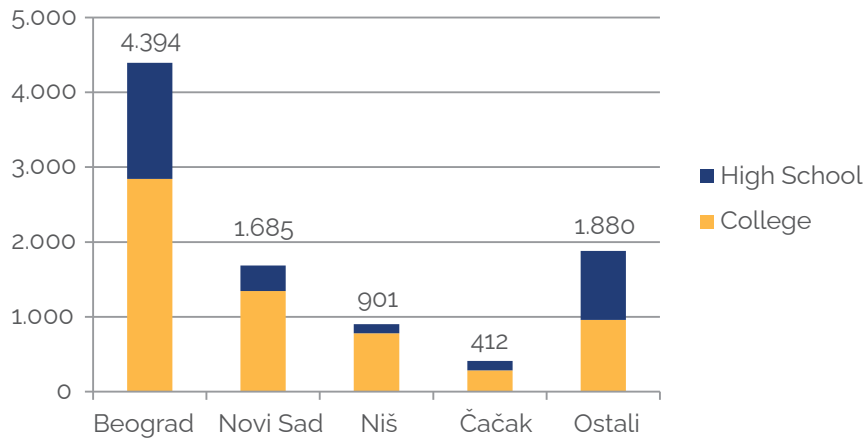
Key messages on figure 37:

- The OAS with 6,049 students (dark blue color) presents the first level degree of tertiary-type A education (B.Sc.) and is, to a great extent (3,330 candidates or 55%) continued with further studies towards MAS and second level degree (M.Sc.), thus securing HR for ICT development.
- For the most successful in tertiary type-A education, the studies are completed with DS (Doctoral studies) and third level degree (Ph.D.), for which 522 places are provided.

- The education that begins with the OSS (dark green color) preserved mostly B.Sc. ICT experts (3,223 candidates), thereof only 824 candidates (25%) continued the (SSS) specialist studies, which shows the practical character of these studies.

More than 20% of all Serbian newly enrolled students in 2020 were ICT enrollees (9,272), which is a clear indicator of interest of Serbian young people in studies related to

Figure 35. *Number of New ICT Enrollees according to Cities, in 2021/2022*



Source: SITO, 2022

informatics. The overall ICT enrolment capacity of around 14,000 is bigger, because all studying programs are split into three level degrees. After the first level degree (B.Sc. academic title), a student can continue his or her studies towards the second (M.Sc.) and third level degrees (Ph.D.). Therefore, students can achieve several academic titles during their studies. Consequently, the number of future ICT experts is limited to the number of new ICT students, but not to the number of academic titles achieved in that year (which we call here “overall enrolment capacity”).

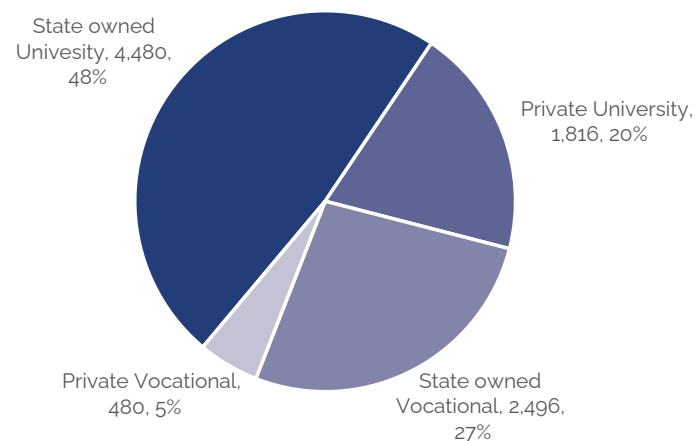
6.1.4. Number of New ICT enrollees according to Cities – Geographical Availability

There are 22 cities throughout Serbia where ICT studies exist, which provides very good geographical coverage. Education of personnel near industry centers is Serbian historical (traditional) heritage and that happens to be a good practice. Unfortunately, in the past two decades, industry was almost completely suppressed, but these preserved education capacities give the hope that faster economic recovery is possible.

6.1.5. Number of New ICT Enrollees by ownership of educational institutions

ICT program is held at 55 High Education institutions: 15 state owned universities, 22 private, 17 state owned (Vocational) Colleges and only 1 private College. Few students opt for private faculties, only 1,816 (20%). This is because the state-owned faculties have a tradition

Figure 36. Number of New ICT Enrollees by ownership of educational institutions, in 2021/2022



Source: SITO, 2022

and studying expenses in their favor. More than 80% of ICT studies held at the state-owned higher education institutions are covered by funds from the state.

6.2. WORKFORCE AND EMPLOYMENT

The total number of graduates in ICT and other technical areas is 10,297 which is 24.8% of all graduate students in 2020 (41,395). Besides this number, 2,164 more graduates come from natural sciences and mathematics. In a general sense, all these graduates can be significant for the ICT sector.

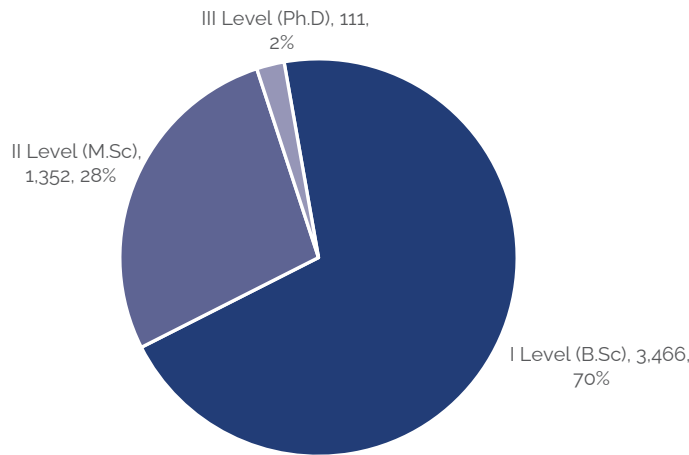
6.2.1. ICT graduates in 2020

In 2021, 4,929 ICT experts have graduated: 3,466 at the first level degree (B.Sc.), 1,352 at the second level (M.Sc.), and 111 at the third level degree (Ph.D.).

Key observations:

- The consolidated data show the structure in which the first level degree graduates are mostly expected (70%);

Figure 37. *Number of Students (vocational and academic) with ICT Titles, in 2020/2021*



Source: SITO, 2022

they are followed by the second level degree graduates (28%) and, finally, as expected, the lowest number of the third level degree (2%).

- At first glance, there are much less graduates than freshmen. When comparing the number of students with ICT diplomas and the number of freshmen, we must remember that enrolment quotas increase every year.

On the other hand, students in Serbia often renew their studies and that the average length of studying was until recently almost double than prescribed one. Besides, quitting studies, employment, or emigration before graduation are common.

- Realistic estimate is that Serbia can count on around 4,000 ICT experts out of 4,929 ICT graduates in 2021, as the remaining number continued their studies towards the second and third level degree.

Reform of university education (Bologna) and increase in number of students show positive results in ICT profiles. Nowadays, Serbia can expect an influx of over 4,000 new ICT experts each year. Further growth is limited primarily by weak demographic factors. Therefore, it is even more important that each ICT student graduates, so that graduation success rate be increased from 60% to 90%, that would increase the number of future ICT experts to between six and seven thousand per year. This number considerably exceeds domestic IT market needs, but well-paid ICT jobs in business tied to foreign markets would easily absorb it.

More resources for raising the number ICT experts exist. This analysis pertains only technical and technology professions, leaving out some 800 students of IT study programs in economic schools and around 500 in math. Additionally, corpus of mechanical engineering has almost 1,500 graduates each year and offers an interesting source of human resources with ICT skills. At last, but not least important, increase of women in ICT studies is needed.

6.2.2. Existing and missing workforce

It is estimated that around 1.6 million of ICT experts will graduate in the EU in the period 2021-2025. The market needs in the same period will amount to almost 2.7 million, while the difference will be filled by employees with informal ICT education and skills. This is why topics of education and need for ICT workforce in Serbia should be seen in the context of wider European perspective – because the forces which work in the EU will, in large part, shape domestic labor market in ICT area. The table below shows the total data for EU, but also separated data for 4 biggest member states, 10 members on the West, and 13 members who joined later (2004 and beyond).

Table 29. *Enrolled ICT students in 2020 and estimates of missing workforce until 2025, Serbia and EU*

		ICT students 2020	Needs until 2025	Missing numbers in 2025
TOP_4 EU-14	West EU	918,910	1,299,100	380,190
Remaining_10 EU-14	West EU	379,540	887,100	507,560
EU-13	East EU	315,065	510,100	195,035
EU-27	Total EU	1,613,515	2,696,300	1,082,785
Total Serbia		30,383	48,100	17,717

Source and processing: SITO, 2021, based on EUROSTAT, http://ec.europa.eu/eurostat/web/products-datasets/-/educ_uae_enrt03

This data shows the number of enrolled ICT students for 2020 (current situation). Estimated needs for experts until 2025 are based on the analyses of (1) present and future employment, and (2) import of software services.

Key observations:

- 1,613,515 is the estimated number of ICT students in 2020.
- 1.6 million new ICT experts for 2021-2025 is approximate to the number of all graduates in all programs. Annually, over 300,000 ICT students graduates in EU at all levels (I, II, and III).
- The estimated needs of the EU until 2025 are 2.7 million

new ICT professionals, based on an increase in the number of ICT professionals of 5% each year by 2025.

- In the period 2016-2021, number of ICT experts in EU-27 grew at an average annual rate of 5.3%.
- The lack of ICT experts is estimated at a 1 million by 2025. Those jobs will be filled partly by workforce without formal ICT education but with work experience and in the other part solutions will be sought after on international labor market through engagement of expert via outsourcing.
- Over two-thirds of the EU's missing workforce goes to four major European countries (Germany, France, Italy, and Spain), with Germany asking for the most.

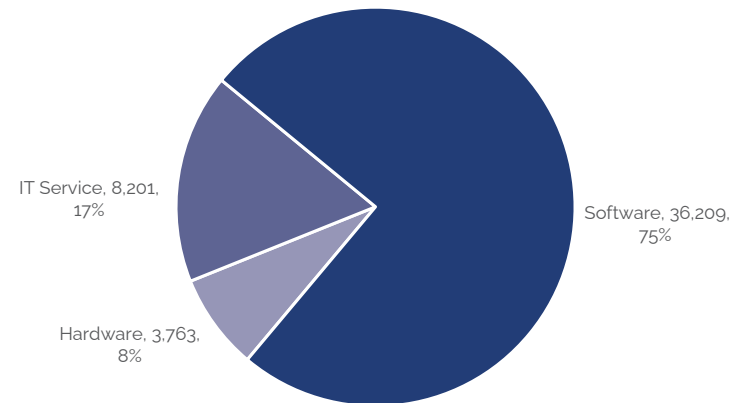
- Projections say that, in the period 2021-2025, between 28 and 30 thousand ICT experts will graduate in Serbia. At the same time, domestic needs are estimated to 50 thousand. The more than of 25 thousand ICT graduates will work for foreign markets from Serbia or abroad. From the point of potentials and increase of ICT workforce that Serbia can use, there are almost no external limits. Future numbers in Serbia, just like the present ones, are modest in comparison to European needs.

6.2.3. Employees by dominant activities

In 2021, Serbian IT¹⁴ employed 48,173 workers. Based on partial research done to date, we estimate that 4/5 are IT experts, while the rest worked in sales, administration, and management. This could seem to be a modest number when compared to 1.5 million employees in all companies and institutions. However, more liberal estimates say that this is just one part of a larger number of 75,000 IT experts and that over 35,000 of these additional workers can be

¹⁴ Companies who submitted their financial reports.

Figure 38. *Workforce structure in IT companies according to their activities, 2021*



Source: SITO, 2022

found in the telecommunication sector, companies that are IT users and in entrepreneurship waters.

Key observations:

- In 2021, employment grew above average in software sector. There were 36,209 employees in these companies, which makes 75% of the total workforce in the IT.

- During the five-year period 2015-2020, number of employees was increased 2.5 times. This represents an impressive annual growth rate of 25%. Under such circumstances, we can expect an increase of employment of 20,000 additional jobs in the coming three years.
- The highest employment rate was registered in the segments of medium enterprises with 16,762 workers and small enterprises with 14,405 – which together makes 65% of total employment. The big companies follow with 19% right in front of micro enterprises with 16%.
- When looking at small and medium enterprises together, we register large employment – almost 27,000 workers, out of which 21,000 in software sector.

6.2.4. ICT Education in EU and Serbia, according to the area and expertise

In 2021, there were 1,613,515 ICT students in the EU¹⁵. That is the majority of experts to be counted on in new employments until 2025. Under ideal conditions, in the period 2020-2025 the EU could count on around 1.6 million of experts with formal ICT education. In the same period, Serbia could expect between 28 and 30 thousand.

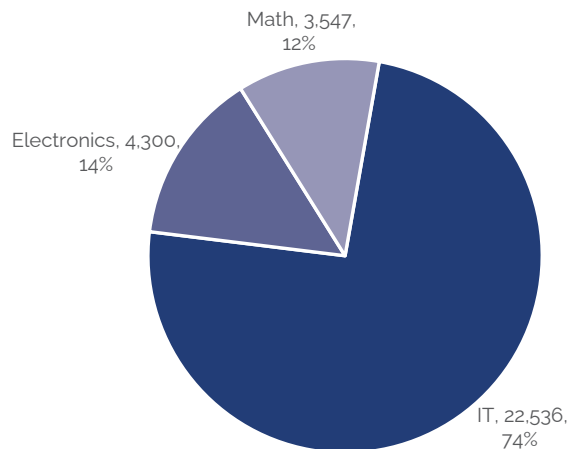
The following table presents the structure of ICT students, according to the following three areas: (1) Information and Communication Technologies (Fo6), (2) Electronics and

Table 30. Number of ICT students, according to the education areas, 2020/2021

		IT	Electronics	Math	Total
EU-14	West	683.115	415.226	200.109	1.298.450
EU-13	East	201.528	91.942	21.595	315.065
EU-27	Total	884.643	507.168	221.704	1.613.515
	Serbia	22.536	4.300	3.547	30.383

¹⁵ ICT areas according to OECD classification (see Annexes)

Figure 39. *ICT students in Serbia 2020/2021 – structure by areas*



Source and processing: SITO, 2021 based on EUROSTAT, http://ec.europa.eu/eurostat/web/products-datasets/-/educ_uoe_enrt03

Automation (F0741), and (3) Mathematics and Statistics (F054). The codes in brackets denote ISCEDF13 area classification (see Annexes).

Key observations from figure and table above:

- Looking at the areas, ICT has the top position with 22,536 students, which makes 74% of the total number of all ICT

students. Electronics and Automation follow with 14%, and Math and Statistics with the remaining 12%.

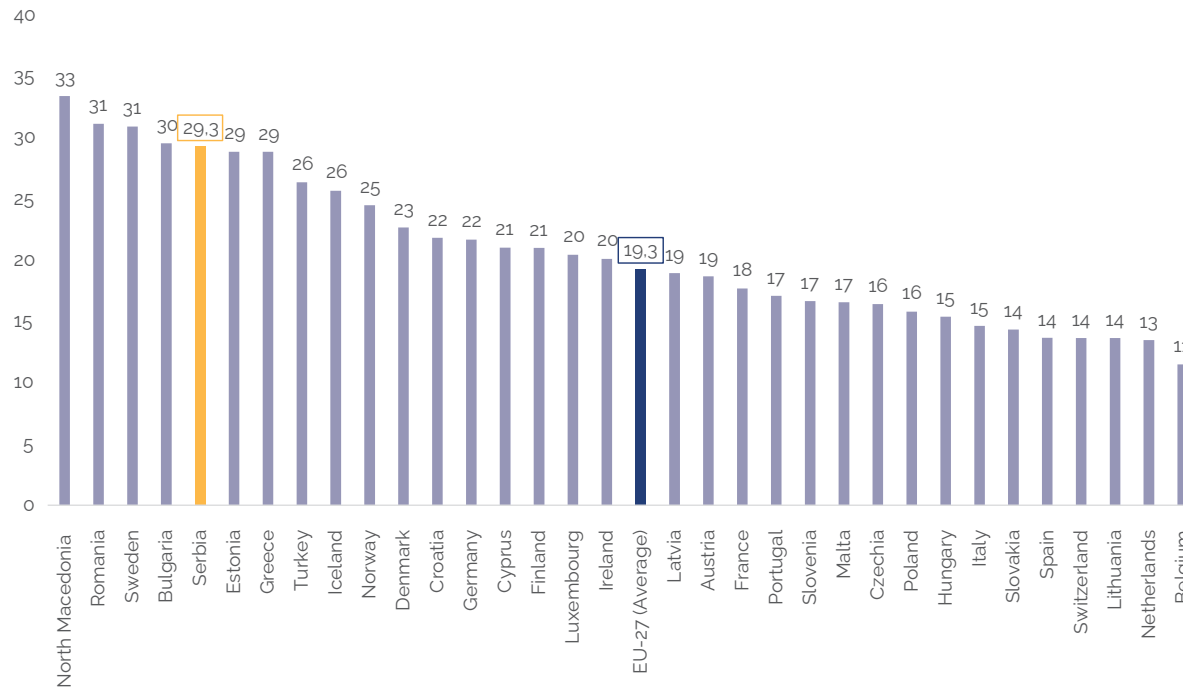
6.3. REPRESENTATION OF WOMEN IN ICT STUDIES – EU AND SERBIA

From the available statistics on studying ICT, Eurostat published the data for the period 2013–2020, while Serbian Statistical Office published the data for the period 2016–2021 and in the same format as in the EU – which makes them comparable. Not much historical data, though. Before, data was incomplete or unreliable, so we will stick to the period after 2013.

The following table shows representation of female population in ICT studies – in the EU member countries and in the EU Accession countries.

Key observations:

- Representation of female population in ICT studies in Serbia is 29,3%, which is 10 percentage points more than the EU average (19,3%).

Figure 40. Representation of female population in the ICT studies, Europe, 2020

Source and processing: SITO, 2022 based on EUROSTAT, http://ec.europa.eu/eurostat/web/products-datasets/-/educ_uoe_enrt03

- Since 1990, women from Eastern Europe enrolled engineering studies significantly more often than women in the Western Europe. We have a similar situation

today in Serbia – engineering studies of electronics and automation attract female population in Serbia more than it is the case in the EU. Female students make 27% of all

students of electronics in Serbia and could raise to over 30%.

Women in ICT studies in Serbia. The largest representation of women, considering the areas of studies, is in math and statistics (61%), followed by informatics (29%) and electronics (26%). In absolute values, the largest number of women is in informatics (6,608), followed by math (2,142), and electronics (1,123).

6.4. ICT AND VOCATIONAL TRAININGS¹⁶

6.4.1. Governance and management of the VET system in Serbia

The key institution responsible for governance of the education sector is the Ministry of Education, Science and Technological Development (MoESTD), which is also responsible for VET. The governance structure also involves the Council for Vocational Education and Adult

Education (CVEAE) and the National Education Council. The CVEAE is primarily an advisory body⁵ established by the Law on the Foundations of the Education System. It can provide guidance on the development and improvement of the quality assurance of secondary VET as well as adult education. Moreover, it contributes to the preparation of strategies in the vocational field and promotes the link between education and the labor market.

Besides the above-mentioned institutions, the following are also active in education quality assessment and improvement: the Qualifications Agency, the National Entity for Accreditation and Quality Assurance in Higher Education, the Institute for the Improvement of Education (IIE) and the Institute of Educational Quality and Evaluation. These public institutions perform different quality assurance processes throughout the Serbian education system.

In addition, the Chamber of Commerce and Industry of Serbia, together with the MoESTD, has a leading role in the

¹⁶ Source: European Training Foundation, https://www.etf.europa.eu/sites/default/files/2020-10/quality_assurance_in_vet_serbia.pdf

implementation of dual education, securing cooperation between employers and the education sector.

6.4.2. Financing

Public secondary education is financed through resources provided by central government and local municipalities. The financing system is input-based, i.e., resources are allocated according to the number of classes within each school. While the central government is responsible for providing resources for staff salaries, the local governments are responsible for other costs, for example those connected with building maintenance, teaching materials, capital expenditure and costs connected with continuing professional development (CPD) of teachers. In addition, schools at the secondary level can generate their own income.

Moreover, employers involved in dual education are asked to cover selected costs, such as student insurance, meals and transport, and personal protective equipment.

6.4.3. Regulatory frameworks

The following key laws frame the Serbian education system: Law on the Foundations of the Education System; Law on Secondary Education; and Law on Adult Education. Two additional laws were adopted in 2017 and 2018: Law on Dual Education and Law on National Qualifications Framework (NQF).

The reform process is supported by the Strategy for Development of Education in Serbia together with the Action Plan for its implementation, which is valid until 2020. The key objectives of the strategy, which covers VET, is the provision of high-quality education for all, an increase of students' coverage and attainment at all levels of education, and increased efficiency and relevance of education. In line with the strategy, progress can be seen, for example, in the promotion of dual education, in supporting access for vulnerable groups, and monitoring and strengthening of CPD opportunities for teachers. The overall quality of the system is based on the following standards: student/trainee achievement standards; quality standards for institutional operations; textbook quality standards; competency standards for teachers; and

competency standards for headteachers. In addition, the Law on NQF introduces the institutional and methodological framework for the development of qualification standards, self-evaluation, and external evaluation standards of providers in non-formal adult education.

In 2019, the Serbian government, through the MoESTD, launched work on the Education Strategy 2030.

6.4.4. Main provider institution types

VET is mainly provided by public institutions. VET is largely school based with varying amounts of time dedicated to practical training/learning in workplaces or in school laboratories/workshops. According to the available statistics, around three-quarters of students at the upper secondary level attended VET programs during the academic year 2017/18. More specifically, 152 723 students were enrolled in four-year programs and 30 407 enrolled in three-year programs.

In addition, the development of dual education is promoted through the Private Sector Development Project and

specific bilateral and institutional agreements, for example through the cooperation between the MoESTD, the Serbian Chamber of Commerce and Industry, the Austrian Chamber of Commerce, and the Austrian government. Dual education is currently offered by 84 schools (i.e., approximately a quarter of VET schools) and covers about 4 500 students.

Adults participate in VET programs organized by both secondary VET schools and different provider institutions in the non-formal sector. Currently, 32 institutions providing training programs for adults are officially recognized by the MoESTD, having passed the established accreditation procedure. In total, 132 programs have been accredited. Moreover, the Qualifications Agency has started the accreditation of private providers according to the Law on NQF.

6.4.5. Main provision/program types

Upper secondary VET is provided in vocational schools and comprises three- and four-year programs that enable direct progression to higher education.

Three-year programs include approximately 35% general and 65% vocational education. According to the established standard, practical classes should be one day per week during the first year of studies up to three days per week in the third year of studies. In general, practical classes take place in school workshops or through a combination of classes in school workshops and in companies. The practical classes in the workplace can be up to 25% of the total number of hours dedicated to the practical classes. For dual education, the practical classes take place exclusively in companies. Final examination takes place at the end of the study program.

Four-year programs include approximately 45% general and 55% vocational education. Although the time for practical classes is lower than for three-year programs, where dual-based profiles exist, in-company training is mandatory.

For adult education, several training programs exist to help learners acquire the necessary professional competences or qualifications based on labor market needs. Currently, 32 institutions providing 121 training programs for adults are formally recognized and accredited.

6.4.6. Main qualifications according to ISCED levels

The existing three- and four-year VET programs are provided at ISCED 3C and ISCED 3B levels, respectively.

6.4.7. Strengths, developments, needs

New developments – in progress/in the pipeline

- Qualification standards are now being developed within the new institutional and methodological framework.
- The Qualifications Agency and sector skills councils are fully operational.
- National state Matura exams, covering both general and vocational Matura, are in the development and testing phase. Implementation is planned for 2021.

Needs and challenges

Challenges in relation to improving quality assurance in VET include the need to:

- establish effective mechanisms for engagement of VET stakeholders, including a legislative framework for social partnership.
- put in place an effective labor market information system.
- progress implementation of the NQF.
- upskill teachers to support changes in VET curricula, qualifications, and quality assurance requirements.
- promote further development of the EQAVET Reference Framework in the national context.



RESEARCH AND DEVELOPMENT

This chapter provides the following information:

- *Current situation regarding R&D in Serbia*
- *EU support dimension – in general and ICT R&D related*

According to the European Commission¹⁷, Serbia is at a good level of preparation in the area of science and research. Some progress was made with the adoption of the new strategy on scientific and technological development for the period 2021-2025 and the action plan for the implementation of the smart specialization strategy. The national level of

investment in research remains low and was even reduced. In the coming year, Serbia should in particular:

- Increase the national funding for research and innovation.
- Transpose the European research infrastructure consortium (ERIC) Regulation into national law.
- Address the actions of the European Research Areas.

¹⁷ European Commission – Commission Staff Working Document Serbia, 2021 Report, Brussels,

7.1. CURRENT SITUATION REGARDING R&D IN SERBIA

The national level of investment in research remains low at 0.89% of GDP with only one third of this amount coming from the private sector.

With regard to measures for the **Innovation Union**, the Serbian innovation fund and the science and technology parks (STP) in Belgrade, Niš and Čačak continue to be active with increased

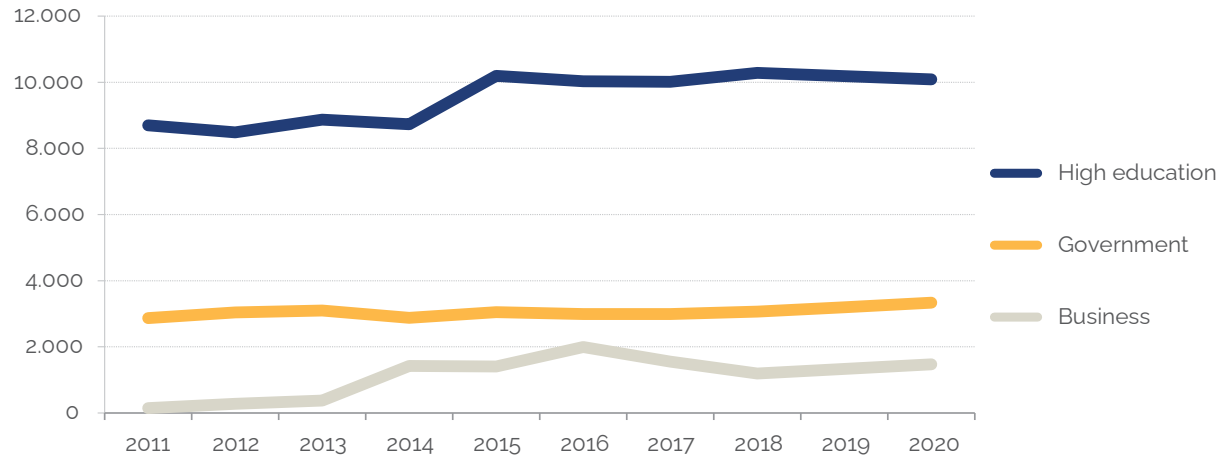
contributions from the budget. The STP in Novi Sad is in the second phase of construction. As the private sector continues increasing its investment in research, significant steps are needed on the public side to support cooperation between businesses and academia. Serbia scores high in the European innovation scoreboard. However, research and innovation expenditures of the private business sector remain too low.

In Serbia, there are 16,662 scientists involved in research and development that is carried out at 54 registered scientific

Table 31. Number and Dynamics of Researchers in Serbia, 2011-2020

Sector	2011		2020		Trend 2020/2011	
	Number 2011	Share 2011	Number 2020	Share 2020	Growth (%)	Gained (p.p.)
High Education	10,506	77.2%	11,695	70.2%	11.3%	-7.0%
Government	2,929	21.5%	3,401	20.4%	16.1%	-1.1%
Business	165	1.2%	1,563	9.4%	847.3%	8.2%
Other	9	0.1%	3	0.0%		
Total	13,609	100.0%	16,662	100.0%	22.4%	0.0%

Source: Statistical Office of the Republic Serbia

Figure 41. *Number (Full time Equivalent) of Researchers in Serbia by Sector, 2011-2020.*

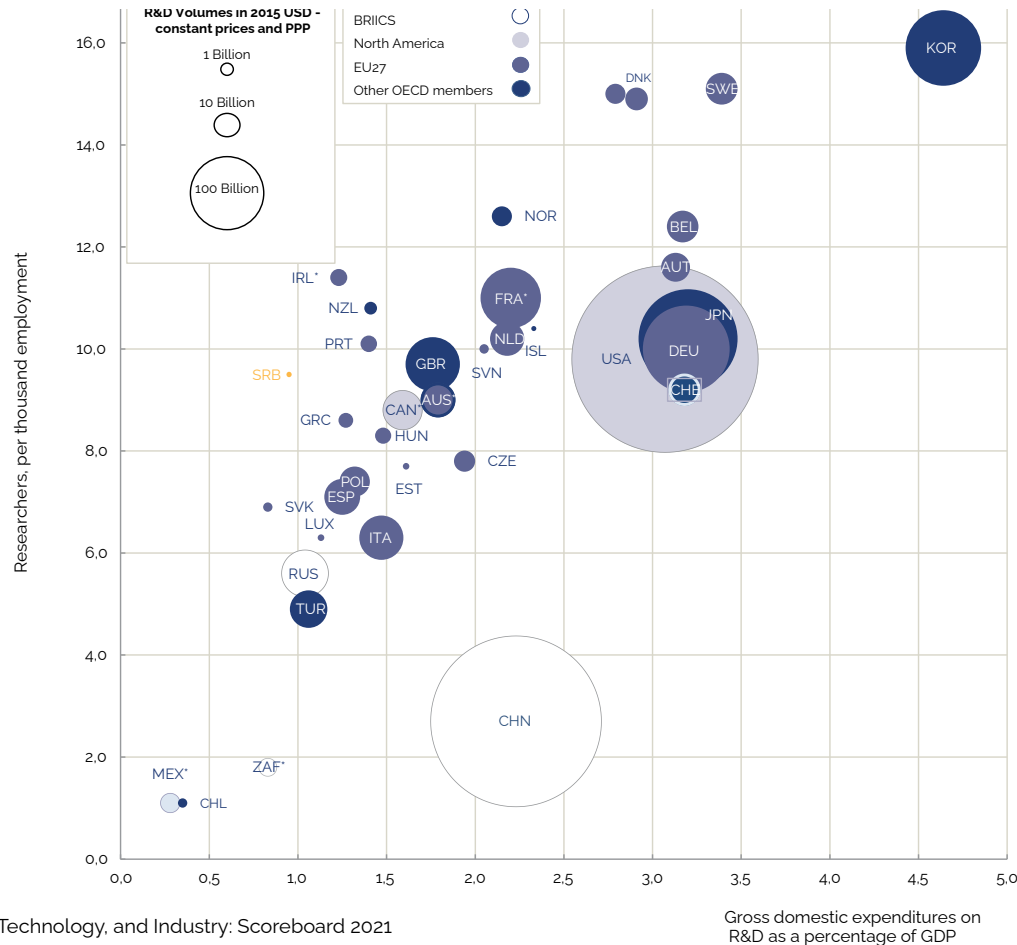
and research institutes and 111 faculties. Most of them are state founded, but they are also the research organizations from the SME business sector (111 enterprises).

Key messages on table 26 and figure 46:

- 16,662 – Number of researchers in Serbia in Serbia 2020.
- 14,891 – Number of researchers according to FTE (Full time Equivalent) in Serbia, 2020.

- The Serbian business sub-sector counts 1,563 researchers. This indicates that dominantly state-owned organizations are recognized by official statistics. In the total number of researchers, in 2020, the business sector was involved with 9.4%, the government sector with 20.4%, higher (tertiary) education with 70.2%.
- The number of researchers employed in the R&D increased in 2020 by 0.2% compared to the previous year

Figure 42. R&D in OECD and non-OECD Countries, 2019



Source: OECD Science, Technology, and Industry: Scoreboard 2021

and total 22% in comparison to 2011. Compound annual growth rate in period 2011-2020 was only 2.2%.

- In the total expenses for the R&D (€424 million) in 2020, the share of gross investments (investments in infrastructure) is 5%, while 95% are actually salaries for researchers (63%), and the rest (32%) for the costs of experiments and operating expenses.

In Figure 47, three components have been compared simultaneously: (1) gross domestic expenditure on R&D as a percentage of GDP; (2) Number of researchers per thousand employed; (3) R&D volumes in euros.

According to the level of investment in R&D (around 0.9% of GDP) and R&D value in 2020 (€424 million) Serbia is positioned low. On the other hand, with 16,662 researchers, which is below 10.0‰ of total employees, Serbia is at the world average. According to the Lisbon declaration, financial resources for R&D in EU members and candidate countries, should reach **1% of GDP from the budget and 3% of GDP in total**.

The value of all investments in Serbian R&D is not even comparable to the world-renowned universities or institutes

whose annual budgets are above €1 billion – each. The Government strategic goal for investment in R&D from national budget, excluding infrastructure, to reach 1% GDP, will not be achieved until the end of 2025. It stopped halfway (around 0.5%).

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

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

The total budget for science in 2020 was €424 million and less than 10% was allocated for Electronics and Telecommunications and Industrial software and informatics.

The private sector in Serbia is still only marginally involved in ICT R&D and the role of ICT R&D business sector in Serbia

is a modest one. There is low or no connection to ICT R&D institutes. However, companies from the private sector are business oriented and long for applied solutions. Between these steps lies currently hidden potential for R&D.

The Government almost exclusively follows up and regulates the relationships inside ICT R&D area of state-owned entities and their financing.

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

7.1.1. Serbian R&D Legal and Policy Framework

On **research and innovation policy**, the main priorities of the European Research Area are incorporated in the new strategy on scientific and technological development 2021-2025, adopted in February 2021. In April 2021, Serbia

adopted an action plan for the implementation of the Smart Specialization Strategy (S3). The Science Fund, established in 2018, is fully operational as a funding mechanism. The action plan for the implementation of the strategy for the development of artificial intelligence for the period 2020-2025 was adopted in June 2020.

7.1.2. EU Support Dimension

Regarding the **EU framework program** and international cooperation, Serbia continues to be active and participate successfully in Horizon 2020 as well as in EUREKA and COST. Serbia should continue to integrate with the new **European Research Area**, in accordance with its plan to increase investment into research and innovation by 50% in the next five years, also given the relevance of innovation to the Economic and Investment Plan for the Western Balkans.

Since the start of participation in HORIZON 2020, 3,995 applications from Serbia have taken part in 3,117 projects proposal and 415 of them have been selected for financing.

Serbia is oriented toward the EU cooperation programs, which is illustrated with a number of joint scientific papers. There is very fruitful cooperation in research and development with the United States, mainly thanks to the Serbian scientific diaspora. Cooperation in Horizon 2020 program with Spain, Italy and Germany follows. CERN cooperation is in the fourth place, right before cooperation with UK. It is understandable that EU scientific area plays an important role for Serbia and its R&D.

7.1.3. Participation in FP7 –R&D Program

EU Commission, which financed R&D of Serbian research through the Seventh Framework Program (FP7), is the most significant international partner for Serbian science. FP7 spans the period from 2007 to 2013, with a budget of €50.5 billion. On June 13, 2007, Republic of Serbia gained the status of Associated Country within the EU Seventh Framework Program for Research and Technological Development.

After FP7 had closed in 2014, the European Commission provided overall data, which revealed that 326 participants from Serbia received €64.1 million.

7.1.4. Current R&D program – Horizon 2020

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

Serbia sees its chance in equal participation in H2020. However, there is a potential for a big financial risk. In previous FP7 Program, Serbian participation in the total budget was around 0.001%. Realistic assumption is to presuppose that Serbian participation in HORIZON 2020 could reach 0.002%, which makes more than €150 million for the period 2014-2020. In 2018, Serbian state commitment to participate in EU programs was at around €13.8 million (RSD 1,626,321,000).

On the other hand, funds received by H2020 project participants in 2014-2020 amounted to €135 million¹⁸. This would practically mean that the poor Serbian economy becomes a financier of rich sciences in the EU, probably putting €20 to €50 million more into the H2020 fund than Serbian participants receive. In order to avoid this threat, **it is necessary to include monitoring system for tracking balance between national budget participation in H2020 and inflows of the research organizations through obtained projects.**

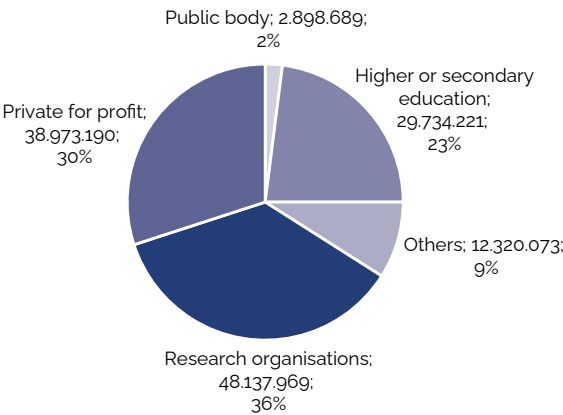
7.1.5. Participation in Horizon 2020¹⁹

On the basis of statistical data for the period 2014-2022 of the Program (by April of 2022) researchers from Serbia participated in the preparation of 3,995 projects applications. Of that number, 415 projects were granted funding, making the success rate of 11.3%. According to the European Commission data, 597 participants from Serbia received €135 million.

¹⁸ CORDIS, Serbia Country Profile 2022

¹⁹ <https://webgate.ec.europa.eu/dashboard/extensions/CountryProfile/CountryProfile.html?Country=Serbia>

Figure 43. *Types of organizations based on the net EU Contribution, Serbia 2014-2022.*



Source and processing: CORDIS, 2022

7.2. ICT R&D CENTERS OF EXCELLENCE (COE)

The Centre of Excellence (CoE) was established in Serbia in mid-2008 according to the Law on Research Activities and following the Rule Book and prepared by the National Council for Science and Technological Development.

Table 32. *Serbia R&D profile 2014-2022. Horizon 2020 Key Figures*

Value	Indicator	Description
597	Participation	Number of organizations involved in H2020 projects. One organization participating in N projects is counted
415	Signed Grants	Number of grant agreements signed
€135 M	Net EU Contribution	Funding received by the project's participants after deduction of their linked third parties' funding
3,995	Applications	Number of organizations applying for Horizon 2020 grants. One organization applying in N proposal is
3,117	Proposals	Proposals that have not failed at the eligibility
11.4%	Success rate	Ratio of the retained proposal to the total number of eligible proposals received
123	SME Participation	Number of SMEs involved in H2020 projects. One SME participating in N projects is counted
5 out of 16	Participation rank in Associated Countries	Ranking position on the participations in H2020 for a country
6 out of 16	Budget share rank in Associated Countries	Ranking position on funding received from H2020 for a country

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

The adopted criteria for identifying the potential CoE is primarily based on the total number of ICT R&D researchers at particular research unit (not the entire organization) combined with the achieved success in

Table 33. *Types of organizations based on the net EU Contribution, Serbia 2014-2019*

Types of organizations	Participation	Net EU Contribution [€M]	Share [%]
Research organizations	125	48,137,969	36%
Private for profit (excl. education)	185	38,973,190	30%
Higher or secondary education	167	29,734,221	23%
Others	60	12,320,073	9%
Public body (excl. research and education)	43	2,898,689	2%
Grand Total	580	132,064,141	100%

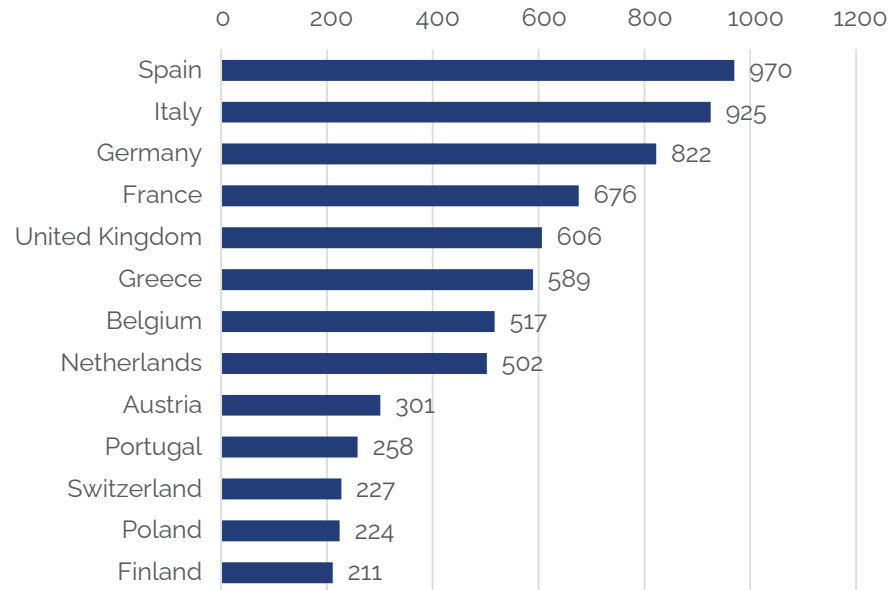
Source: CORDIS, 2022

"HORIZON 2020" projects. Whenever it was possible (based on the public available data or good estimation), the number of implemented projects and number of published scientific papers were considered. In addition, the high expertise and/or market approval in ICT area of the entities were considered. Based on the criteria above, the selected entities were classified into three groups of potential CoE: a) centers of competence, b) centers of potential for "ICT-HORIZON 2020", and c) centers of best practice. One entity was classified into not more than two categories.

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

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

(c) **Centers of Best Practice** – are exclusively ICT companies (from business and industry sector) which

Figure 44. *Serbia in H2020. Collaboration with other countries.*

Source: CORDIS, 2022

have a good market reputation, strong references, have been recognized and are well known by specific expert community, or recommended from the person of authority (in specific areas).

Around 100 organizations have been identified as potential CoE: 40 centers of competence, 15 centers of potential for HORIZON 2020-ICT and 45 centers of best practice. The authors are aware that such a list is not complete. There

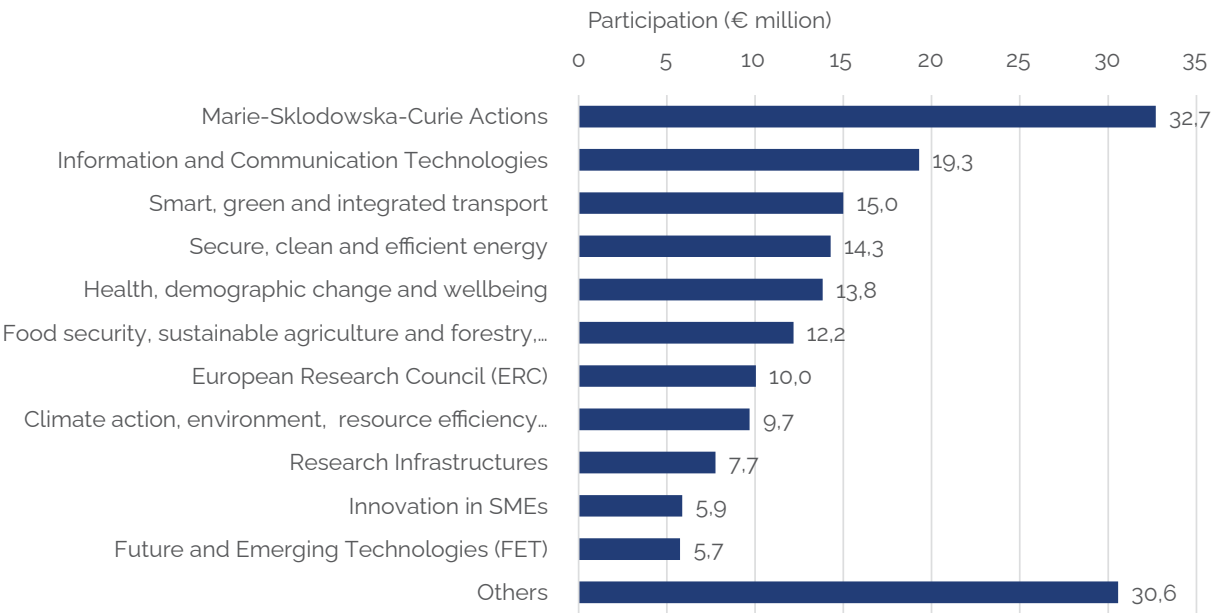
Table 34. *Centers of Potential for ICT-HORIZON 2020 in Serbia*

ORGANISATION	Number of Participation in HORIZON 2020	Sum of Contribution in HORIZON 2020 [€]	Number of employees, 2020
BIOSENSE INSTITUTE, NOVI SAD	38	30,992,721	79
INSTITUT MIHAJLO PUPIN, BEOGRAD	21	5,360,991	173
FTN – UNIVERZITET U NOVOM SADU	12	4,081,550	NA
VOJVODJANSKI IKT KLASER	4	3,652,549	NA
NISSATECH INNOVATION CENTRE, NIŠ	11	3,151,300	13
PMF – UNIVERZITET U NOVOM SADU	17	2,767,721	NA
INOSENS, NOVI SAD	15	2,760,512	11
DUNAVNET, NOVI SAD	7	2,678,877	14
BIOIRC, KRAGUJEVAC	6	2,577,998	22
BELIT, BEOGRAD	7	2,041,923	38
TAJFUN HIL, NOVI SAD	5	1,692,940	34
MYSKIN, BEOGRAD	2	1,663,348	8
RT-RK, NOVI SAD	2	1,270,625	478
ETF – UNIVERZITET U BEOGRADU	4	773,754	NA
REALAIZ, BEOGRAD	5	637,131	22
DNET LABS DOO NOVI SAD	3	583,738	2

ARVRTECH D.O.O. NOVI SAD	2	528,746	6
NOVELIC, BEOGRAD	1	467,700	45
BGW, BEOGRAD	2	361,979	30
DARWIN DIGITAL DOO BEOGRAD	1	298,045	12
ENERGOINFO GROUP-SCINET D.O.O.	1	294,000	0
ZENTRIX LAB DOO	1	268,375	0
EIPIX ENTERTAINMENT DOO	1	254,744	1
NEXTGAME DIGITAL DOO BEOGRAD	1	250,820	4
MBRAINTRAIN D.O.O.	1	217,826	10
WIPL-D DOO BEOGRAD	1	213,725	16
COPRIX MEDIA D.O.O.	1	167,160	2
VISION EQUIPMENT D.O.O.	1	148,750	1
ELSYS EASTERN EUROPE DOO	1	98,000	162
PANONIT, NOVI SAD	1	72,000	83
VLATACOM INSTITUT, BEOGRAD	1	50,000	120
TOTAL – ICT	176	70,379,547	1,386

Source: CORDIS, 2022

Figure 45. *Net EU Contribution (EUR) by thematic priority*



Source: CORDIS, 2022

are ICT entities which have participated in HORIZON 2020 projects, both successfully and unsuccessfully, in non-ICT areas which have not been considered. In addition, there are ICT entities (research groups and individuals) inside organizations whose basic field of work is not ICT.

ICT R&D Expertise

The first ICT-Leadership in Enabling and Industrial Technologies (LEIT) Work Program under H2020 provides a balanced response to the main challenges faced by

Europe in the field: firstly, the need to maintain a strong expertise in key technology value chains; secondly, the necessity to move faster from research excellence to the market.

Serbian R&D organizations should be introduced to H2020 themes and objectives and map their expertise accordingly. In addition, it is of great importance for Serbian research teams to take part in ICT-LEIT activities thus expressing their higher interest in international cooperation as well as strengthening their skills and expertise. Six main activity lines have been identified as compatible with the Serbian R&D in the ICT-LEIT part of the Work Program:

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

Although mapped to FP7 themes (objectives) expertise, the table below is a good illustration of the ICT R&D expertise

Table 35. *Competence/Share Matrix of Declared Expertise per Objectives in ICT R&D*

High competence – high share

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

Source: CORDIS 2015, EC-DG INFSO (FP7-ICT Theme Call 4 inclusive)

in particular areas. All objectives (High competence – High share) with the square frame, are confirmed expertise and successful FP7 projects.

Table 36. *ICT R&D potentials in registered organizations*

#	Title	University	www
1.	Higher Education		
1.1.	School of Electrical Engineering	University of Belgrade	www.etf.bg.ac.rs
1.2.	Faculty of Organizational Sciences	University of Belgrade	http://www.fon.bg.ac.rs
1.3.	School of Mathematics	University of Belgrade	www.matf.bg.ac.rs
1.4.	School of Technical Science	University of Novi Sad	www.ftn.uns.ac.rs
1.5.	Technical School Mihajlo Pupin	University of Novi Sad	www.tfzr.uns.ac.rs
1.6.	School of Sciences	University of Novi Sad	https://www.pmf.uns.ac.rs
1.7.	School of Electronic Engineering	University of Nis	www.elfak.ni.ac.rs
1.8.	School of Technical Sciences	University of Kragujevac	www.ftn.kg.ac.rs
1.9.	School of Computing	Union University	www.raf.edu.rs
2.	R&D institutes		
2.1.	Mihajlo Pupin Institute	University of Belgrade	http://www.pupin.rs
2.2.	IRITEL		http://www.iritel.com
2.3.	RT-RK R&D Institute		http://www.rt-rk.com
2.4.	BioSense Institute		http://biosense.rs
2.5.	Vlatacom Ltd.		http://www.vlatacom.com
2.6.	Military Technical Institute		http://www.vti.mod.gov.rs
3.	Science institutes		
3.1.	Institute of Physics	University of Belgrade	http://www.ipb.ac.rs/index.php/sr
3.2.	Vinča Nuclear Institute	University of Belgrade	http://www.vin.bg.ac.rs

ANNEX 1: CENTERS OF LARGE IT POTENTIALS IN PRIVATE AND PUBLIC SECTORS

Nine faculties, six R&D institutes and two scientific institutes make the scope of this analysis. The list of organizations follows.

Further research needs to be focused on recognition of excellence centers both in private and public sectors, in order to identify key actors with R&D and innovation potentials in the area of ICT.

Table 37. (a) *Centers of best practice*

	Title	Established	www
1	Comtrade SI Ltd., Belgrade	2001	http://www.comtradegroup.com
2	SAGA Ltd., Belgrade	2003	http://www.saga.rs
3	Asseco SEE Ltd., Belgrade	1990	http://www.asseco-see.com
4	Telegroup Ltd.	2001	https://www.telegroup-ltd.com
5	ATOS IT Solutions and Services	2010	http://rs.atos.net/sr-cs
6	Informatika JSC.	1989	http://www.informatika.com
7	S&T Serbia Ltd., Belgrade	1996	http://www.snt.rs
8	E-Smart Systems Ltd., Belgrade	2000	http://www.e-smartsys.com

Table 38. *(b) Centers of business solutions*

	Title	Established	www
1	M&I Systems Co Ltd., Novi Sad	1991	http://www.mi-system.co.rs
2	DIGIT Ltd., Belgrade	1990	http://www.digit.co.rs
3	ASW Engineering Ltd., Belgrade	1992	http://www.asw.eu
4	AB Soft Ltd., Belgrade	1990	http://www.absoft.rs
5	IIB Ltd., Belgrade	1990	http://www.iib.rs

Table 39. *(c) Centers of competence*

	Title	Established	www
1	Schneider Electric DMS NS Ltd., Novi Sad	2008	http://www.schneider-electric-dms.com
2	Nordeus Ltd., Belgrade	2010	http://www.nordeus.com
3	Levig Global Sourcing Balkan Ltd., Novi Sad	2005	http://www.levig.com
4	Comtrade Solutions Engineering	2013	http://www.comtrade.com
5	Seven Bridges Genomics	2011	http://www.sbgenomics.com
6	HDL Design House Ltd., Belgrade	2002	http://www.hdl-dh.com
7	H-Tech Ltd., Belgrade	2008	http://www.htec.rs
8	Execom Ltd., Novi Sad	1997	http://www.execom.eu

Table 40. *(d) Centers of R&D potentials*

	Title	Established	www
1	BitGear Wireless Design, Belgrade	2007	http://www.bitgear.rs
2	Inosens Ltd., Novi Sad	2014	https://inosens.rs
3	Novelic	2012	http://www.novelic.rs
4	Belit Ltd., Belgrade	2000	http://www.belit.co.rs
5	DunavNet Ltd., Novi Sad	2006	http://www.dunavnet.eu
6	Nissatech Innovation Centre Ltd., Niš	2009	http://nissatech.com
7	BioIRC Ltd., Kragujevac	2008	http://www.bioirc.ac.rs

The criteria for identification of a potential excellence center are based primarily on the total number of researchers in a particular research unit (not entire organization) in combination with track record in European projects (Horizon 2020).

- Whenever possible, based on publicly available data or good assessment, number of completed projects and published scientific papers should be considered.
- High expertise and/or market confirmation in the R&D.

- The chosen approach makes possible for practical identification of potential centers of excellence, circumventing formal and restrictive criteria proposed by laws.
- Future work needs to establish if each entity complies with conditions from any of four distinct categories: a) centers of best practice, b) centers of business solutions, c) centers of competencies and d) centers of Horizon 2020 projects potential.

ANNEX 2: ICT CLUSTERS AND SUPPORT ORGANISATIONS

Serbian IT companies have established a strong presence on foreign markets through successful marketing of their own solutions, being able to provide the highest quality outsourcing services and creating solid partnerships. Thus, Serbia has emerged as a very interesting alternative location for development of sophisticated software: an hour or two by plane from major European locations, harboring educated and experienced IT workforce, and delivering world-class quality while still keeping it all at a fraction of the costs in the West – no wonder the year-on-year growth in turnover for the past 10 years was in the high 20s or low 30s percentiles!

Setting up clusters helped companies accelerating networking and reap the benefits of joint activities. These clusters give necessary institutional support to performances of the Serbian IT industry and make their

members visible internationally in a more structured way than it was the case in the previous years.

Apart from IT cluster, we list here other organizations, governmental and non-governmental, who offer support to ICT companies, R&D, and in other areas.

Vojvodina ICT Cluster – VOICT

Vojvodina ICT Cluster – VOICT provides a single point of contact with the best IT companies in Serbia, employing 6,000+ experienced IT professionals. VOICT builds long-term relationships based on trust and quality, bringing expertise, experience and excellence to each and every project.

Serbian IT companies, in general, made a noticeable breakthrough, putting Serbia on the map as a source

of top-quality IT products and services. VOICT is giving institutional support to this trend, mobilizing players from other domains, such as education and government.

The cluster has its own **Cluster Academy**, organizing trainings and workshops targeting the needs of the members and wider IT community, as well as a dedicated **Project Office** that grows its project portfolio every year.

More about VOICT at www.vojvodinalCTcluster.org

ICT Network Serbia Cluster – ICT Net

ICT Network (ICT Net) is a non-for-profit business association of startups, companies, individuals, BSOs, academic and research institutions devoted to the development of ICT sector in Serbia. It was established in 2010 and today association counts more than 50 members, including support organizations such as Business Technology Incubator of Technical faculties Belgrade, Regional Agency for Development and European Integration of Belgrade and Centre for Technology Transfer. Association actively works in triple helix model (public sector, private sector, and

academia) for almost 10 years and have great experience in the creation of affirmative environment for companies, building of industrial capacities, cross sectoral cooperation and fostering knowledge sharing and capacity building. With numerous stakeholders in Serbia and region and extensive network of strategic partnerships, ICT Network actively works on innovation, promotion of new solutions, legal frameworks, and attraction of venture capital.

Core Competences: Networking; Organizing matching events and business delegation; Organizing conferences and professional events; Training and advisory services to SMEs; Promotion, Communication; Dissemination; Raising awareness; Stakeholder cooperation; Capacity building; Network development.

More about ICT Network / <https://www.ict-net.com>

Digital Serbia Initiative

Digital Serbia Initiative (DSI) is a non-profit, non-governmental organization with the strategic goal of developing a strong, globally competitive digital economy in Serbia.

DSI aims to create a business climate that serves the digital economy by investing in strategic programs in the areas of formal and informal education, startup ecosystem development, legal and regulatory frameworks, digital infrastructure, and public dialogue on digital transformation.

DSI's biggest strength lies in more than 30 member-organizations from all sectors relevant for the growth of a digital ecosystem.

More at <http://www.dsi.rs>

Niš Cluster of Advanced Technologies – Ni CAT

The NiCAT is a cluster initiative that comprises more than 30 high tech companies, four scientific research institutions (Faculty of Electronic Engineering and Faculty of Mechanical Engineering – University of Niš, Singidunum University and Metropolitan University) and three economic development support institutions (Regional Development Agency RDA South, Regional Chamber of Commerce and Think Innovative Hub). The Cluster's goals are to increase the turnover of the cluster members both on national and

international markets; strengthen the capacities of the companies for technological development and innovations and to develop new technological products and services.

The NiCAT values are integrity, change, partnerships, innovation, and technology. Why NiCAT? Engineering is in the NiCAT's blood and DNA (\$600M in electronic industry export in the mid-70s of the 20th century. The NiCAT is passionate about quality and excellence (cluster's members work with the most demanding clients). The Cluster has proven results of companies (Award Winners, 20 innovative companies - grants and investments) and global reach (clients on all continents and business ambassadors on three continents) with competitive prices.

The promotion of the City of Niš as a favorable location for business operations in the advanced technology field is a strategic focus. In a relatively short period of time, the Niš Cluster of Advanced Technologies has implemented a number of things and has established partnerships with important national and international institutions.

More about NiCAT at www.ni-cat.org

ICT Cluster of Central Serbia – ICT CS

ICT CS is a business association which gathers ICT enterprises, institutions, and organizations from Central Serbia. The cluster is based on geographical center of Serbia, in the City of Kragujevac. The cluster was established in 2013 with the goal to provide institutional support for further development of the ICT sector in Central Serbia. ICT CS aims to enhance the competitiveness of ICT businesses as well as their visibility on domestic and international markets. This IT association but gathers 29 members – 15 companies from the IT industry, plus educational institutions, consultant organizations, a startup center, and a business incubator.

One of the main focuses of the cluster is to create respectful knowledge base in order to strengthen impact at the regional, national, and international level through building capacities of the cluster's members, implementation of marketing activities, development of services designed for cluster members, development of services designed according to the market needs, formulation, promotion,

and provision of sources of funding for cluster's initiatives and projects.

More about ICT CS at www.ict-cs.org

Startit / South-Eastern Europe ICT – SEE ICT

Startit, also known as SEE ICT, is a social enterprise movement committed to developing Serbian society by promoting technology and entrepreneurship. Started in 2007, they inform, inspire, and educate their audience about opportunities in digital economy and connect them to career and business opportunities.

They do this with their media outlets (main one being startit.rs), where they have published 7,000 articles over the years, reaching peak readership of 100,000 in the late 2019. Their national network of tech community event and co-working spaces is unique in its reach and activities, with 8 cities, where they host 500 events with 20,000 visitors per year. They employ a team of 30 people full time.

One of the pioneers in fostering the startup community, their flagship acceleration program was first in Serbia and started in 2012 and has been recognized by becoming the first in Europe to become part of Google's global acceleration network, accelerating over 200 startup teams so far. Their latest project is Tesla Nation which aims to brand Serbia's tech industry to global audiences.

More about Startit at www.startit.rs

Chamber of Commerce and Industry of Serbia

The Chamber of Commerce and Industry of Serbia also serves as a good role model in mobilizing and networking ICT sector companies and professionals. The Chamber's Association of Information Technologies and its four groups: for hardware, software, communication, and e-commerce, gather all Serbian IT companies.

The Chamber has good communication lines and potential for policy advocacy, recognized by ICT companies. In cooperation with line ministries, SIEPA, clusters and

business and professional organizations, the Chamber is active in organizing conferences, forums, international and domestic fairs, vocational training, and other events that serve the purpose of development in the ICT sector. The Chamber is also active in organizing B2B events, networking Serbian ICT companies with their peers from the Western Balkan region and other countries.

More about SCC at www.pks.rs

BioSense Institute

The BioSense Institute explores scientific and technological frontiers regarding the innovative use of ICT in agriculture and strives to deliver disruptive, state-of-the-art digital solutions to the European farming sector. BioSense uses everything that ICT has to offer to change the face of agriculture today and to improve its efficiency. Thanks to such demand-driven and transdisciplinary research, the Institute rose to prominence internationally and is recognized by the European Commission as a "scientific lighthouse in the region". That is reinforced by the fact that

BioSense participates in more than 30 European projects, most of them from the Horizon2020, the EU Framework Program for Research and Innovation. One of the biggest strengths of the Institute is strong and diverse startup ecosystem and through the BioSense accelerator, we provide both business and scientific support to Agrifood-Tech entrepreneurs in the region. The Institute is constantly developing a prosperous ecosystem engaging the industry, farmers, research institutions and governmental bodies to join forces towards social well-being. It also stimulates entrepreneurship, economic growth, and employment at regional level, reducing environmental footprint and preventing brain drain.

More at <http://biosens.rs>

The Innovation Fund

The Innovation Fund (IF) is the key state institution supporting innovative activities and managing financial resources for

stimulating innovation. The IF aims to promote linkages between the research and business sectors, encouraging the development of innovative technologies and products. Operational since 2011, the IF is designed to increase the capacity of technology startups and SMEs through various financial instruments.

The application and selection process through IF programs are designed to identify and fund projects that have clear market potential and are proposed by startups, SMEs, and consortium with clear growth objectives. Highly qualified external evaluators perform the first part of the evaluation/technical review, followed by the Independent Investment Committee's final decision for financing made via consensus after live pitch event. The number of awards is determined by the quality of the proposals and limited by the total funding allocated to the IF programs.

More about IF at <http://www.inovacionifond.rs/fond/about-fund>

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