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Abstract

Information and communications technology is the infrastructure and components that enable modern computing. Competitiveness, innovation and job creation in the European context are being increasingly driven by the use of new information and communication technologies. This needs to be backed up by a workforce that has the knowledge and skills to apply these novel technologies efficiently. The objective of this study is to analyse trends in ICT and bridge the current gap in digital skills in southern Europe. The research focus was on three countries Greece, Cyprus and Bulgaria and for the needs of the project, two rounds of the Delphi technique were conducted seeking consensus on the most prevalent and important digital skills that are setting the trend for the upcoming years. Results indicate a dynamic scenery of digital skills that are most needed in order to advance into the transformative period of progressive ICT technologies and bring to the surface the new megatrends in ICT.

CHAPTER 1: A GLIMPSE AT THE WORLDWIDE LANDSCAPE OF ICTs

1.1 A bigger picture

Digitalization and modern technologies are having a great impact on global economy as complete industries have been revolutionised fundamentally, while the way people think, live and work has also been significantly transformed. ICT, or information and communications technology (or technologies), is the infrastructure and components that enable modern computing. Although there is no single, universal definition of ICT, the term is generally accepted to mean all devices, networking components, applications and systems that combined allow people and organizations (i.e., businesses, non-profit agencies, governments and criminal enterprises) to interact in the digital world.

The World Bank, numerous governmental authorities and non-government organizations (NGOs) advocate policies and programs that aim to bridge the digital divide by providing greater access to ICT among those individuals and populations struggling to afford it. These various institutions assert that those without ICT capabilities are left out of the multiple opportunities and benefits that ICT creates and will therefore fall further behind in socio-economic terms. The United Nations considers one of its Sustainable Development Goals (SDG) to "significantly increase access to information and communications technology and strive to provide universal and affordable access to the internet in least developed countries by 2020." Economic advantages are found both within the ICT market as well as in the larger areas of business and society as a whole.

For businesses, advances within ICT have brought a few of cost savings, opportunities and conveniences. They range from highly automated businesses processes that have cut costs, to the big data revolution where organizations are turning the vast trove of data generated by ICT into insights that drive new products and services, to ICT-enabled transactions such as internet shopping and telemedicine and social media that give customers more choices in how they shop, communicate and interact.

Table 1.1.1 What is actually happening?

What is actually happening?
<ul style="list-style-type: none"> Between 2005 and 2019, the number of Internet users grew on average by 10 per cent every year.
<ul style="list-style-type: none"> The global penetration rate increased from nearly 17 per cent in 2005 to over 53 per cent in 2019.
<ul style="list-style-type: none"> An estimated 4.1 billion people are using the Internet in 2019, reflecting a 5.3 per cent increase compared with 2018.
<ul style="list-style-type: none"> In developed countries, most people are online, with close to 87 per cent of individuals using the Internet.
<ul style="list-style-type: none"> In the least developed countries (LDCs), on the other hand, only 19 per cent of individuals are online in 2019.
<ul style="list-style-type: none"> Europe is the region with the highest Internet usage rates, Africa the region with the lowest Internet usage rates.
<ul style="list-style-type: none"> Almost the entire world population (97 per cent) lives within reach of a mobile cellular signal.
<ul style="list-style-type: none"> The number of active mobile- broadband subscriptions per 100 inhabitants continues to grow strongly, with an 18.4 per cent year-on-year growth.
<ul style="list-style-type: none"> Mobile-cellular subscriptions have also continued to grow, while fixed-telephone subscriptions continue to decline steadily.

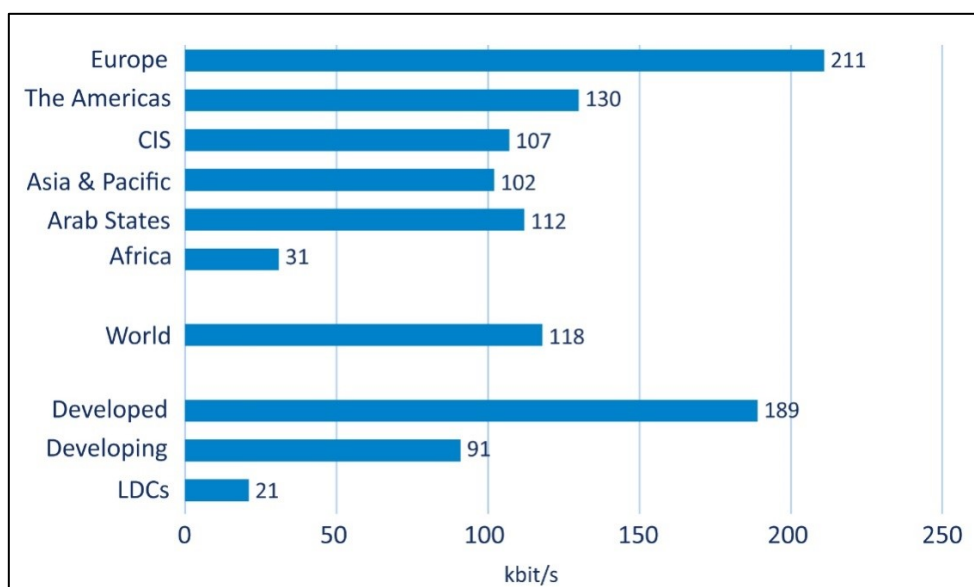
Source: Self Elaboration

Figure 1.1.1 Components of ICT



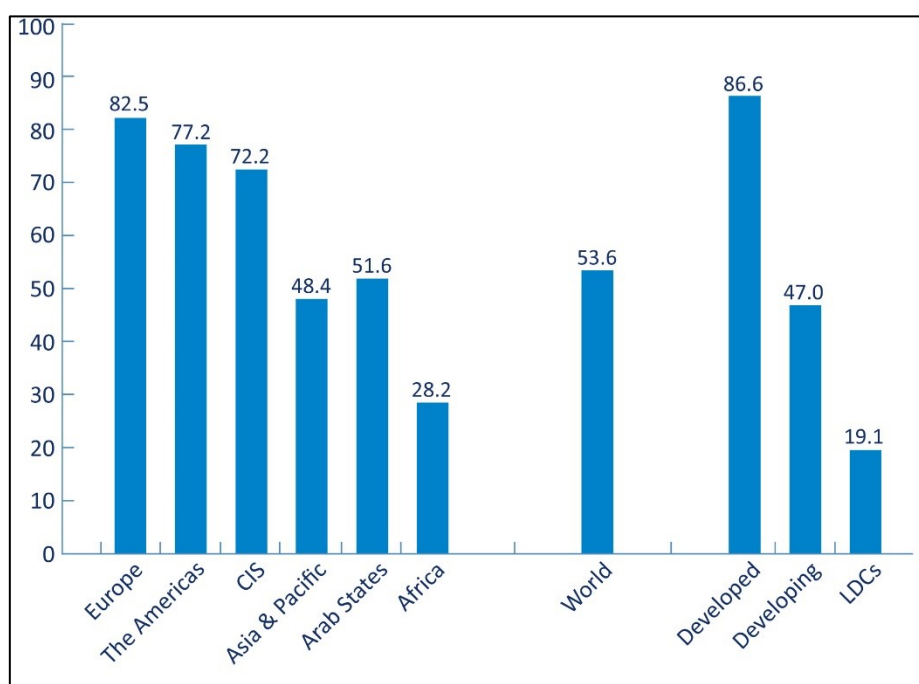
Source: <https://searchcio.techtarget.com>

Figure 1.1.2 International bandwidth usage per Internet user (kbit/s), by region 2019



Source: ITU

Figure 1.1.3 Percentage of individuals using the Internet, by region and development status, 2019.



Source: ITU

1.2 ICT & European Union

In 2015 the EU ICT sector Value Added was 581 billion Euros, employed 5.8 million people and spent 30 billion Euros on R&D (BERD) business expenditures. The ICT sector represented 3.9% of the EU value added in 2015, 2.5% of the employment, 15.7% of total BERD, and 18.6% of the R&D personnel and 20.6% of the researchers. In general, the ICT sector in 2015 was more dynamic than the whole EU economy, as value added increased 5.2%, employment 1.8% and BERD 2.9% (see Table 1 (b)). The ICT GBARD in the EU was 6.4 billion Euros, which represented 6.7% of total public funding in R&D (total GBARD) and 0.04% of total GDP.

The unprecedented growth of the Information and Communication Technologies sector accelerated spectacular shifts in societies and employment trends worldwide. By 2016, 1 in 5 enterprises (20%) in the European Union employed ICT specialists. Adoption of the latest digital innovations became a key factor in the overall competitiveness of economic regions and national economies, as well. As for Central-Eastern Europe, most of this region performs outstandingly well in the above-mentioned field, leading to a closing gap in salaries and employment shares in the ICT sector between the Eastern and Western parts of the continent. With these positive trends, CEE is slowly heading towards shedding its previously earned competitive edge with a relatively cheap and valuable ICT workforce.

European labour market is projected to be lacking more than 670,000 ICT professionals in 2020. This rapid increase challenges policymakers, stakeholders and economic actors, not only in Central-Eastern Europe, but all across Europe to find new ways of collaboration with higher education institutions and the private education sector to ensure the number and quality of the ICT workforce for the next decade. In addition, the requirements that the sector has to comply with are changing with a similarly fast pace, which trend leads to a constant need of developing knowledge, competencies, and soft-skills.

In 2018, some 8.9 million professionals worked as ICT specialists across the EU-28 which makes up 3.9 % of the total workforce of the countries researched. This also means that in only ten years, the number of ICT specialists in the EU has increased by more than 40%. While the broadening employment in the ICT sector is

unprecedented, storm clouds are already gathering in the sky as the demand for e-skills keeps growing at a quick pace. In 2020, the European labour market is projected to be lacking more than 670,000 ICT professionals as SMEs and multinational companies are competing for ICT workforce to be able to correspond with the urging needs of digital transformation. While big enterprises are more likely to fill the gaps with own employees, SMEs usually work with external suppliers.

Although ICTs continue to be an effective resource for reducing existing costs, they are increasingly regarded as a tool for innovation and revenue growth through the creation of new services and ways of working in value chains and networks. As these new high-intensity activities unfold (not only in the service sector but also in the construction sector), new specialized intermediaries, who take over the non-core business processes of other companies, are given the opportunity to focus

Competitiveness, innovation and job creation in the European industry are being increasingly driven by the use of new information and communication technologies. This needs to be backed up by a workforce that has the knowledge and skills to apply these novel technologies efficiently. Given the transversal role of digital competences in the economy, a shortage of ICT specialists and workers with advanced ICT skills could hamper Europe's growth objectives. Digital transformation should be supported with a wide-range of actions on the governmental level.

Europe's future competitiveness lies on its ability to stay relevant in areas that are the most likely to generate innovation and growth in the short term and this aim requires training and educating the digital workforce in the right direction.

1.3 Current issues

Elemental ICT infrastructure such as simple computer networks and internet access is now a key asset for most businesses regardless of sector. These technologies are now so widely used that they are considered essential for the operation of businesses. In contrast, advanced infrastructures and information services are more important in the future economy than systems and technology, as they allow and encourage the

creation of new ways of managing business relationships and new models of entrepreneurship in an evolving digital economy.

Currently, Europe suffers from a lack of professional ICT skills and a lack of digital literacy. These shortcomings exclude many citizens from the digital society and economy and are a hindrance to the large multiplier effect on productivity growth due to ICT assimilation. This requires a coordinated response, with Member States and other stakeholders at the forefront.

The magnitude of the digital skills challenge requires a long-term strategy and new partnerships between European, national, regional, public and private players including civil society.

1.4 The digital skills gap in Europe

Having a digitally skilled labour force and population, more broadly, is crucial for the creation of a Digital Single Market in Europe and for receiving its benefits, for European competitiveness and for an inclusive digital society. Currently, however, 44% of European citizens do not have basic digital skills. 37% of people in the labour force – farmers, bank employees, and factory workers alike – also lack sufficient digital skills, despite the increasing need for such skills in all jobs.

Europe also lacks skilled ICT specialists to fill the growing number of job vacancies in all sectors of the economy. A crucial issue underpinning this is the need to modernise our education and training systems, which currently do not prepare young people sufficiently for the digital economy and society, and to move to a life-long learning approach so that people can adapt their skills sets throughout their life-times as needed.

Figure 1.4.1 The metro map of the Great Coalition of Europe Committee on Digital Jobs



Source: <http://ec.europa.eu/digital-agenda/en/grand-coalition-digital-jobs-0>

CHAPTER 2: GREECE and ICTs

2.1 Introduction

The ICT sector is one of the most important sectors for the Greek economy, due to the growing demand for automation and digitization in both the private and public sectors. Greece has a well-qualified staff, and high-level professionals with international experience and entrepreneurial spirit. In this context, the dynamic support of ICT development initiatives through public as well as private schemes (business incubators, R&D centers, collaboration sites, etc.), as well as the strong technological infrastructure of the country, is also contributing to this.

The Greek ICT sector offers unique opportunities for investing in value-added services globally, utilizing skilled human resources, existing know-how and research capabilities, strong infrastructure and excellent living and working conditions. The establishment of software development centers and microchip & MEMS creation centers are just a few examples of high performance opportunities in Greece that already enjoy government support and can be properly staffed with the available and well trained human resources. In the coming years, ICT investment opportunities are expected to increase significantly, mainly through:

- The need for further automation and digitization in the public sector, which will be achieved through major ICT projects.
- The rapid adoption of new technologies by the Greek public and the high penetration rate, new communication devices (smart phones, tablets), broadband telecommunications and smart TVs.
- Significant progress has been made in the development of technology clusters, incubators and accelerators, in addition to vigorous activity in new investments - investment funds initiatives (e.g. Equifund, NSRF).
- The many innovative research activities currently underway in the Greek Higher Education Institutions, in particular in areas such as cloud computing, location services, nanotechnology and smart systems.

The ICT market in 2018 compared to 2017 recorded growth of 2.1% (EUR 5,591 billion. In 2019 according to the European Information Technology Observatory (EITO) estimated growth of 1.4%, i.e. the market will have a turnover of 5.667 billion Euros, while in 2020 the percentage increase is limited to 0.2% (to 5.676 billion Euros).

The picture on the two separate pillars of the ICT sector in Greece differs. IT is showing greater strength, as 2019 expanded by 3.6% (1.856 billion), while in 2020 the increase will be 1.1% (1.876 billion). The telecommunications market in 2019 was up marginally 0.3% (to € 3,811 billion), while by 2020 the mark is negative although still marginal (down 0.3% to € 3.799 billion). In 2018 Telecommunications growth was 1%, while in 2017 it was down 1.6%.

The image of the ICT market in Greece shows this stagnation since 2007, except in 2014, when it achieved positive performance and in 2017, it remained stable. The performance of 2019 is an improvement over previous years, as in 2016 the decline was 2.8%.

2.2 ICT Job market in Greece

The public sector in Greece is particularly affected by the impacts of an aging workforce and suffers from a shortage of administration managers. Increasingly, private sector organisations are also recognising that this shortage needs to be addressed if business operations are to be maintained. Long-serving staff has in-depth knowledge that is relied upon by other staff, particularly in environments where little effort has been put into capturing or managing knowledge in the organisation. The lack of knowledge transfer and development within organisations in combination with aging workforce are the main reasons for shortages. Additional reasons include sectoral development and redistribution of skilled workers as well as stagnant technological infrastructure. In relation to ICT professionals two different trends are observed. On one hand, despite improvements in the ICT and telecommunications market in the last two years and despite positive expectations for 2016, job opportunities for ICT technicians group are overall still low. This can be explained by the fact that many ICT businesses (particularly SMEs) have closed down due to heavy taxes. Based on 2014 data from EUROSTAT and 2008 data from Invest Greece Agency the number of employees in ICT in Greece dropped from approx. 62 thousand in 2008

to approx. 51 thousand in 2014. On the other hand, over the last 10 years the ICT labour market in Greece has been characterised by a rapid rate of occupational change, driven by the emergence of technologies requiring new skills and new ways of working. As a result, serious skills shortages have occurred. A possible solution is the provision of continuing training to employees to enhance the acquisition of new skills and new ways of working.

In the modern economies, but also in Greece, although at a slower pace, especially now with the financial crisis, technical and related professions of medium and high qualifications are becoming increasingly important. Also, jobs that used to require low-profile profiles today, and more in the future, will require medium or high-level profiles. The service sector is expected to widen the gap between high and low-skilled jobs in the sense that demand and jobs are falling at intermediate levels. This is, inter alia, because the evolution of technology reduces the demand for many traditional office occupations, while at the same time making jobs more demanding and less 'routine'.

The main changes that have been observed in recent years in occupations relate to requirements in new specific technical skills. These changes are expressed with greater dynamism and are somehow more visible in the so-called technical professions because they are directly influenced by technological change. These internal changes are often so significant that the same occupations are gradually transformed into new occupations. Thus, many jobs today require the combination of new vertical specialized and horizontal skills, thereby introducing an employee profile that has a primary specialization along with a second specialization combined with broader knowledge and skills.

Numerous interviews from studies and international literature mainly indicate the need for specialized or up-to-date information and internet skills in all occupations, by farmers and artisans, who need to be informed on crop issues, product use guidelines, hygiene and safety rules, etc. up to business management executives. The shift towards the development of online sales, especially through internet and mobile telephony, is a prime example in this case.

In the field of IT, new specialties and specializations are constantly being created as a result of the rapid technological developments, as well as the spread of IT and telecommunications applications in all sectors of the economy.

The Association for the Diagnosis of Business Needs in the Occupations and Skills of the Association of Businesses and Industries has documented that until 2020 87 critical occupations are emerging which in terms of knowledge, skills and competences are linked to the competitive evolution of the Greek economy, and in this sense positive employment prospects. Regarding the ICT sector they are:

- Mobile Applications Developer
- Software Engineer (Developer)
- Systems Analyst/ Network Planner
- Business Analyst
- Digital Media Specialist and/or Web Master
- Network Engineer
- Enterprise and Systems Architect
- Development and Network Engineering Management
- Information Systems / Network Quality Manager
- ICT Security Manager
- Hardware Engineer
- Software Development and Hardware Installation Control Specialist
- Product and/or Services Manager
- ICT Project Manager
- Database & Data Center Administrator
- Business Information
- Network Manager

Besides these occupations based on a study of the national qualification certification agency and professional orientation from international giants, global trends and demands a few new emerging occupations on the ICT sector are:

- AI Architect
- Cloud Architect

- Cyber security Engineer
- Business intelligence analyst
- Data (analyst, scientist, engineer)
- DevOps engineers
- Network/cloud administrator/IT expert specializing in cloud technology
- Systems administrator
- 3D printing technologist
- Application manager in hospitals, diagnostic centers, etc.

2.3 Mismatch priority occupations for Greece

Looking at past, current and future trends (3-4 years), a number of occupations have been identified as mismatch priority occupations for Greece, i.e. they are either in shortage or surplus. Shortage occupation: an occupation that is in short supply of workers, and for which the employers typically faced difficulties finding a suitable candidate. Surplus occupation: an occupation for which there are plenty of suitable workers available but low demand. The employers have no problems filling such posts. The list presented below is based on an assessment of the labour market of Greece. The occupations presented are not given any rank. All of them present high mismatch (Skills Panorama, 2016).

Table 2.3.1 Mismatch Occupations, Greece

Shortage occupations	Surplus occupations
Business services and administration managers	Building frame and related trades workers
ICT operations and user support technicians	Mining and construction labourers
Sales, marketing and development managers	Wood treaters, cabinetmakers and related trades workers
	Painters, building structure cleaners and related trades workers

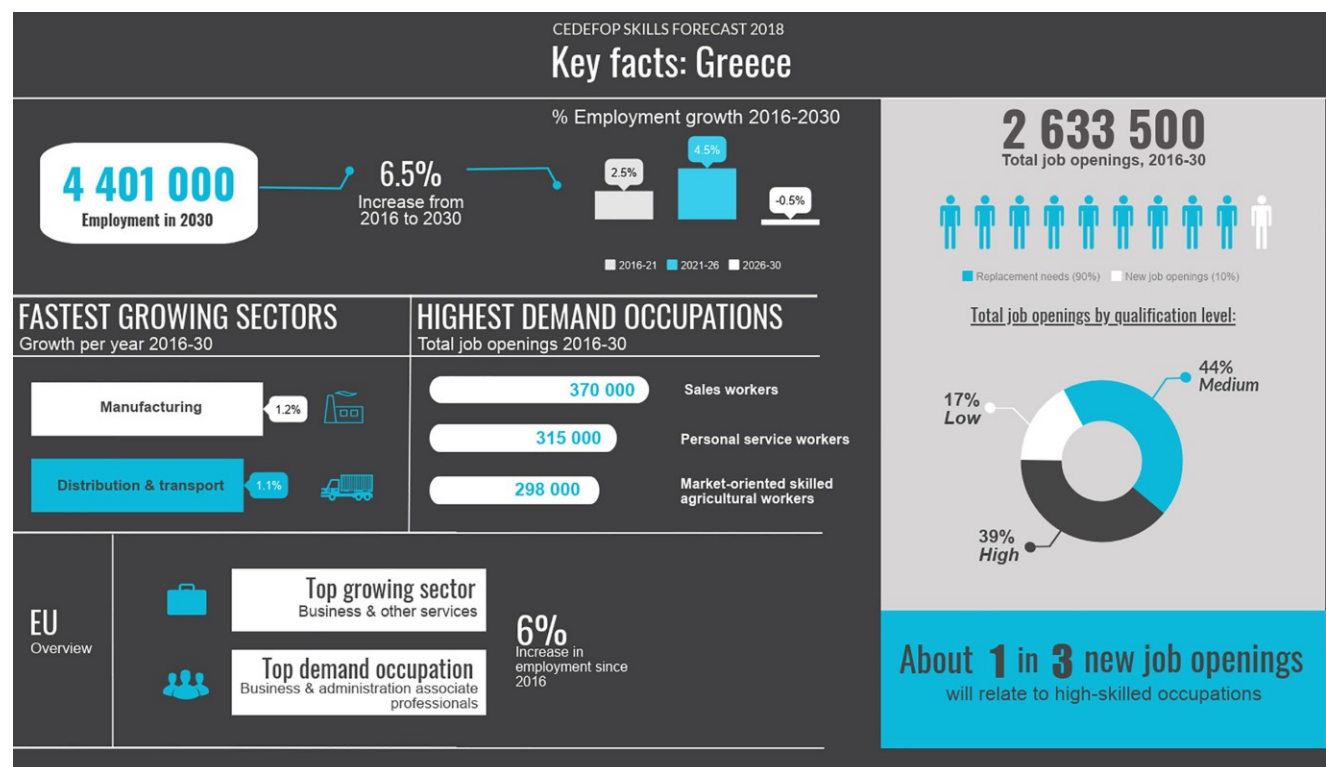
Source: Self Elaboration

2.4 Direction forecast for Greece

In the coming years, the trend of increasing employment rates in the service sector will continue, at the expense of employment in the primary and secondary sectors in Europe 27, a forecast that also applies to Greece.

The next generation labour market requirements will be different, and will vary in terms of sectors, occupations / skills and level of qualifications. Studies and international literature show that there is not so much a tendency to seek new jobs, but mainly new skills. The demand for new skills in today's job market is constantly changing, either because of the demand for products and services in the market, or because of changes arising from technological and scientific developments. That is why, among other things, the specialties that today are likely to have good employment prospects in the future may be depreciated or no longer in demand (CEDEFOP, 2018).

Figure 2.4.1 Key facts for Greece



Source: <https://www.cedefop.europa.eu/>

2.5 New demands new skills

Regarding the rise of new occupations in the ICT sector for Greece and international in the section we will introduce for each ICT occupation the most demanded and emerging skills for 2020.

1. Mobile Applications Developer

The industry for mobile application development continues to grow as mobile devices become the center of communication and work. At an impressive rate, business and technological development has emerged, causing an increased demand for experienced mobile application developers. There are a few required skills that are on high demand for mobile applications developers:

- **Cross-Platform App Development.** It is vital to have knowledge of multiple operation platforms in the current industry.
- **Knowledge of popular programming languages (Preferably multiple).** Languages such as Java, Python, C#, Javascript, PHP for Android and Swift and Objective-C for iOS, HTML 5, CSS are some of the most widely used languages.
- **Cyber security Guidelines.** Integrating app security in mobile app development is crucial.

2. Software Engineer

- **Computer programming and coding.** Java, Python, C#/.Net, Mean, Ruby.
- **Software development.** Software developer jobs are projected to increase by a whopping 24% from 2016 to 2026, the Bureau of Labor Statistics reports. One driving force behind this rapid job growth is the advent of new applications on smart phones and tablets. Also, more computer systems are being built into consumer electronics.
- **Object-oriented design (OOD).**
- **Problem solving and logical thinking.**
- **Teamwork.** Interpersonal skills are crucial for software engineers.

3. Systems Analyst/ Network Planner

- **Marketable Skills.** Business intelligence analysis, business systems integration, business & information systems administration, software development, data processing, technology & project management, risk management, and soft skills are some of the marketable skills.
- **Analytical Skills.** Understanding the requirements of the client and study the various ways in which the requirements can be met.
- **Capacity Planning.**
- **KPI.**
- **Transmission Control Protocol/Internet Protocol Tcp/Ip.**

4. Business Analyst

- **SQL Proficiency (Structured Query Language).**
- **Solutions Development.** Knowledge of an end-to-end system's development life cycle. Solutions Development is a process that involves evaluation of requirements, selection of the right solution, proposal of value improvements and implementation of the solutions.
- **Communication Skills.**
- **Technical Skills.**

5. Digital Media Specialist and/or Web Master

- **Company Website Skills.**
- **Javascript.**
- **Adobe Photoshop.**
- **PHP.**
- **CSS, HTML.**
- **Content Management Skills.**
- **Marketing Skills.**
- **Web Analytic Skills.**
- **Website and Graphic Design Skills.**
- **Soft Skills.**

6. AI Architect

Artificial intelligence (AI) is becoming increasingly commonplace in business and in consumer's lives. In 2020, companies will be on the hunt for skilled workers to help meet the demand for AI-enabled products and services. Most companies look for an AI architect who has at least a master's degree in computer science, data science or AI as well as past experience working in data or analytics. Some in demand skills needed:

- **Machine learning and natural language processing skills.**
- **Strategic thinking, time management and organizational skills.**
- **Knowledge of AI application programming.**
- **Experience with change management.**

7. Business Intelligence Analyst

- **Experience with database queries.**
- **Stored procedure writing.**
- **Online analytical processing (OLAP).**
- **Data cube technology.**
- **Strong written and verbal skills.**

8. Cloud Architect

- **IT service management (ITSM).**
- **Vendor management.**
- **Knowledge of state-of-the-art cloud technologies and architectural principles.**
- **Experience with scaling cloud applications.**
- **Understanding of cost, performance and architecture of cloud systems.**
- **Collaboration and communication skills.**

9. DevOps engineer

DevOps practices encourage faster code deployment with fewer deployment failures, so more companies are hiring engineers with DevOps experience to oversee coding, scripting and processes development. DevOps engineers often manage IT

infrastructure, provision resources, oversee software testing and monitor performance after release. Critical skills needed:

- **Coding and scripting skills.**
- **Automation, data management and IT operations skills.**
- **Deep understanding of DevOps best practices.**
- **Strong communication and interpersonal skills.**

10. Network or Cloud Administrator

Network administrators are responsible for handling LAN/WAN protocol, software and hardware. Cloud administrators are responsible for handling cloud initiatives and the networking services and applications that support cloud initiatives in the company.

- **Troubleshooting and communication skills.**
- **Analytic and diagnostic skills.**
- **A willingness to be on call after hours.**
- **Professional certification.**

11. System Administrator

- **Experience with servers, backup and recovery and installing, patching and upgrading software.**
- **Experience troubleshooting and resolving hardware, software and networking problems.**
- **Certifications such as the Microsoft Certified Systems Administrator (MCSA), Microsoft Certified Systems Engineer (MCSE) or Sun Certified System Administrator (SCSA).**

12. Data Specialist

- **Experience gathering and processing raw data.**
- **Ability to provide insights into data sets and to communicate findings to business leaders.**
- **Identifying new sources of data for the organization.**

- Experience working with technology and engineering teams on data integration projects.

13. Cyber security Engineer

- Intrusion Detection.
- Software Reverse-Engineering.
- Analytical Skills.
- Incident Response.
- Risk Mitigation.
- Encryption Technologies.
- Penetration Testing.

14. Hardware Engineer

- Circuit Boards.
- Printed Circuit Board (PCB).
- Hardware Design.

CHAPTER 3: CYPRUS and ICTs

3.1 Introduction

As with other sectors in the Cypriot economy, the ICT market in Cyprus continues to benefit from a-better-than-expected recovery from the financial crisis that hit its painful nadir back in 2013. GDP growth exceeded 4% in each of the last two years, and while this rate is expected to slow somewhat over the next two or three years, healthy growth of around 3% is forecast by the European Commission. The Cypriot ICT market (including telecommunications) reached a value of €659.39 million in 2018, representing year-on-year growth of 3.0%. The IT market (excluding telecommunications) was valued at €210.05 million, representing year-on-year growth of 6.5%. Spending on IT services reached €100.33 million, up 9.0% year on year.

Cypriot companies are beginning to see the strategic importance of infrastructure optimisation, consolidation, and transformation after some resistance to invest in ICT in recent years. They now understand that adoption of new technologies is necessary to remain competitive. These initiatives will typically be driven by lines of business and will demand the utilisation of solutions such as mobility, Big Data analytics, application programming interfaces (APIs) for new services, machine learning, and robotic process automation. Companies from the manufacturing, utilities, transportation, and retail industries, among others, will need to integrate Internet of Things (IoT) technologies as they optimise corporate IT operations in support of business needs. This presents services providers with great opportunities to become trusted advisors and implementation partners, and capitalise on the uptake of innovative technologies by addressing the concerns of companies around new technology adoption, business cases, best practices, and adding value to customers' organisational goals (Toskova et al., 2019).

A recent roadmap for a 2030 vision was created by EPOQPartners, a private consultancy firm newly established in Cyprus, which outlined the potential of Cyprus to harness growth with a technology-driven economy. To remain competitive depends on how Cyprus adapts to new realities like virtual banking, technology in agriculture, new and renewable energies, as well as smart cities. The report also identified significant potential in further developing medical and financial technology. Sparking new growth in sectors through technology would benefit the country and help diversify its economy. In the next five years, Artificial Intelligence (AI) is also set to significantly change the way companies conduct their business. Business success will depend on how new technological capabilities will be utilised. Education and retraining will be a key to effectively harness technology and to adapt to new realities (Cyprus Profile, 2019).

Key drivers of the ICT market in Cyprus (Christodoulou, 2019):

- Cyprus GDP growth rate has been 4% which is above EU average.

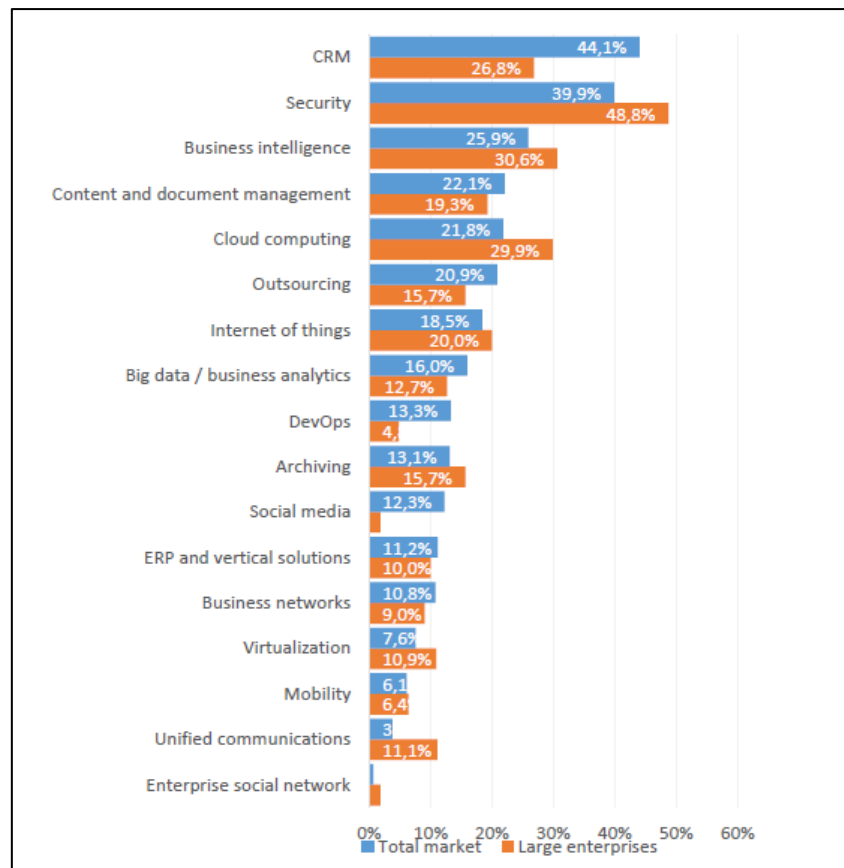
- Unemployment rate from 15% in 2013 will decline to 5.5% by 2021.
- Adoption of new technologies.
- GDPR and governmental regulation measures.
- IT talent shortage.
- National broadband project.
- Cloud uptake.

Table 3.1.1 Challenges facing Cypriot large companies 2019 vs 2017

	2019	2017
Top challenges	Digital transformation Security Cost reduction Automation Business process improvement	Security Business process improvement Cost reduction Staying up to date with technology Migrating to new software/hardware
Important challenges	IT and business alignment Leveraging company data Staying up to date with technology Migrating to new software/hardware Recruiting new staff	Recruiting new staff Meeting internal user requirements IT and business alignment Digital transformation Leveraging company data

Source: Cyprus Computer Society

Figure 3.1.1 IT investment priorities in 2019



Source: Cyprus Computer Society

In 2019, the government pledged to double expenditure on developing technology and increase private contribution as part of a 2019-2023 national strategy on Research and Innovation. The proposal—branded ‘Innovate Cyprus’—envisioned the future of the country as a dynamic and competitive economy with research, scientific excellence, innovation, technological development and entrepreneurship at its core. A recent roadmap for a 2030 vision was created by EPOQ Partners, a private consultancy firm newly established in Cyprus, which outlined the potential of Cyprus to harness growth with a technology-driven economy. To remain competitive depends on how Cyprus adapts to new realities like virtual banking, technology in agriculture, new and renewable energies, as well as smart cities (Cyprus Profile, 2019).

3.2 Sector of Opportunity

The biggest spender by far on IT in Cyprus is the financial sector, followed by the telecoms providers and the public service. Support and training services form the largest primary market in Cyprus, followed by project and outsourcing services. There is currently big demand for support services and skills training in ICT, especially as communications are moving increasingly to 3rd Platform technologies, such as mobile, cloud and big data systems, and with businesses competing to stay ahead of the game. Cloud solutions are beginning to gain more traction in Cyprus with the main providers,

Cyta, epic, Primetel and Cablenet all offering cloud services, which are primarily used by small to medium sized enterprises (SMEs). Services and software are expected to be the top-performing segments of the Cypriot IT market in the coming years, due to continuing demand for quality end-to-end solutions that focus on enhanced user experience. Innovation and specialisation will certainly be key elements to succeed in the Cypriot market, which is rapidly embracing the digital culture and mindset.

3.3 IT Talent Shortage

As companies progress on their digital transformation journeys and inevitably require expertise in the implementation and utilisation of new technologies, they increasingly feel the effects of skills shortages. The most common ways to deal with the lack of skilled IT human resources are to up skill current employees, cooperate with universities to ensure graduates have the required skills, and to rely on external services providers with the right expertise, often alongside the adoption of standardised service delivery models such as public cloud. Some organisations also attempt to bring in workers from Eastern Europe. The lack of IT experts is likely to remain a concern over the coming years, as it is already one of the main challenges facing organisations across the EU. Companies are under increasing time pressure on many fronts, including the need for real-time access to data, real-time analysis of data, fast market release of new products and services, shortened application development cycles, and faster deployment of IT solutions. This time pressure results in increased adoption of technologies (real-time analytics, IoT, private cloud), services (public cloud, business process reengineering (BPR) consulting, agile software development), and methods (DevOps) capable of saving companies' time (IDC) (Toskova, 2019).

3.4 Cyber security and Cloud Computing sector

Development in the cyber security area in Cyprus are for the most part driven by the industries such as (shipping, financial services), but heavily influenced also by the advent of the online gaming industry in the island. It is a developing area where there is room for companies seeking to differentiate and provide practical hands on services which companies can immediately put into use and witness the benefits rather than theoretical one-size-fits all solutions of low benefit to the adopters due to their general purpose.

A company which stands out offering a variety of services from the wider cyber security area is Dexterity Solutions Ltd (cyber.dexterity.com.cy). For the rest, the island does not currently have something significant to report as the major players from the industries which operate from the island are turning to big names in the area from abroad. As adopters however, they use state of the art software and tools for cyber security as required by their size, customer base and reputation. This however does not say much about the state of play in the island as all advice and expertise is from abroad (Zioło, 2019).

On the bright side, there is a national cyber security strategy addressing the following objectives (OCECPR):

- Address cyber crime
- Citizen's awareness
- Critical Information Infrastructure Protection
- Develop national cyber contingency plans
- Engage in international cooperation
- Establish a public-private partnership
- Establish an incident response capability
- Establish an institutionalised form of cooperation between public agencies
- Organise cyber security exercises
- Strengthen training and educational programmes

The nature of cloud computing is such that there is zero need for a local provider of such services. Nevertheless, there are companies in Cyprus, such as IBS offering a range of services on the cloud. The adoption of cloud computing models by Cypriot industries is around the EU average. Cypriot SMEs are commonly family businesses which are passed from one generation to the next while Cypriot youth is for the most part highly educated and a significant number has attended universities abroad receiving state of play education. As a result, there is a positive attitude towards adoption of such technologies while at the same time they make sense due to the lack of significant infrastructure and expertise in the island constituting the cost of acquisition and maintenance of traditional infrastructure expensive (Zioło, 2019).

3.5 Skills Gaps a Barrier to Digital Transformation

Digital transformation clearly stands out as the overarching priority of large companies (100+ employees) in Cyprus, across all industries. While more than 9 in 10 companies claim to have a digital transformation strategy in place, they struggle with a series of obstacles when executing it. Companies typically struggle with the lack of support from employees, the lack of a clear business case, and the lack of expertise within the company or at ecosystems partners. The lack of expertise comes from a gap in the technology- and business-related digital skills between the needs and the existing capabilities of companies, further accentuated by the difficulties in finding and hiring new talent (as it was indicated among the top challenges of companies).

Most Cypriot companies are struggling with significant skills gaps in relation to IoT, artificial intelligence, and traditional application development (see table 3). The situation is better with security, big data analytics, and cloud, although nearly one in four companies continue to face a skills gap in those areas. Due to their managed innovation activities and strategies to create a technology-enabled competitive advantage, large companies have a heightened need for digital competencies, and are struggling with significant skill gaps around almost all emerging technologies.

3.6 IT Services Trends

The overall market and the large enterprise segment (100+ employees) show different pictures when it comes to potential and readiness for emerging technologies. Large companies (100+ employees) seem to be less ready to implement cognitive/AI, RPA, block chain, and AR/VR technologies than the overall market. IDC believes the reasons are a mix of objective and subjective factors. Among the objective reasons are the higher complexity of the organisational, process, and architecture changes needed to implement these technologies, alongside a more conservative approach to gauging accurate ROI on technology investments. The subjective reasons relate to the enthusiasm for and the inaccurate knowledge of technology, its benefits, and fit with smaller companies' organisational goals, which skews the evaluation of readiness in the total market toward the positive side.

Large companies regard IoT as the primary emerging technology to focus on in the short term, and cognitive/AI and RPA as the next wave. Robotics — if only limited to manufacturing and some adjunct industries like logistics and warehousing — also represents a solution with high potential and readiness, as well as relatively high current levels of usage too. When it comes to the overall market (including smaller companies), cognitive/AI and RPA stand out as the emerging technology solutions with most potential and highest readiness among companies to adopt them (Toskova, 2019). The high scores can be attributed to certain solutions like chat bots or online recommendations in the AI space, or simple financial or payroll RPA solutions that are of particular interest to numerous smaller companies.

3.7 Building a Digital Future and Future Outlook

According to IDC as reflected in forecasts, the following market forces will have a direct impact on the Cypriot market in the coming years:

- **Solid economic growth:** Cyprus has largely recovered from the financial and economic turmoil that hit the country five years ago. Steady economic growth of 3–4% and a healthy overall economic environment, including stabilisation of the banking sector, are basic prerequisites for development of the ICT industry. The recently found deposits of natural gas off the Cypriot coast are also expected to positively contribute to the country's economy. Improved economic performance naturally goes hand in hand with high business confidence.
- **Government support for ICT infrastructure:** The government is aware of the potential of ICT to improve the performance of all major verticals of the economy. That is why it introduced an ambitious broadband plan to reach 100% coverage with high-speed Internet access of at least 100Mbps by 2020.

Additionally, temporary concessions to test 5G mobile services have been awarded to all major providers, and the commercial launch is expected to take place next year.

- **Innovation and start-ups:** As the above-mentioned drivers could be limited by the lack of qualified ICT personnel, the government also offers financial incentives for innovative start-ups, including start-up visas for international talents from non-EU countries. Also, local universities and technology institutes are stepping up their efforts and producing an increasing number of highly skilled graduates in order to meet the demand from Cypriot companies.
- **Digital transformation:** Digitalisation of core processes is crucial for organisations in both the public and the private sectors in order to keep up with an increasingly dynamic competitive environment and provide improved services to internal and external users. The result of digital transformation should be the restructuring of organisational processes, especially those pertaining to customer service and information management.

Table 3.7.1 Overview of ICT Markets in Cyprus 2016-2021

Market Segments	2016	2017	2018	2019	2020	2021	CAGR (%) 2016–2021
Total ICT Market	640.74	640.12	659.39	678.14	695.80	712.29	2.1%
Total IT Market	190.94	197.31	210.05	222.87	235.29	246.62	5.3%
Total Telecommunications Market	449.80	442.81	449.34	455.28	460.51	465.67	0.7%
Total IT Equipment	68.00	70.11	72.60	74.90	76.72	78.26	2.9%
Total IT Services	89.04	92.03	100.33	108.91	117.76	126.09	7.2%
Total Software	33.90	35.17	37.13	39.05	40.82	42.27	4.5%

Source: IDC, 2019

With fresh commitment from government to launch incentives and invest in the country's tech landscape, Cyprus could see substantial growth in this sector in the coming years. The country is renowned for its skilled workforce and universities, and research institutes are providing growing numbers of highly qualified graduates to meet the sector's growing demand and carrying out several ground-breaking and technologically innovative projects. Modernising public administration, upgrading networks, and promoting entrepreneurship are key goals for Cyprus to strengthen its global competitiveness in a truly digital future (Cyprus Profile, 2019).

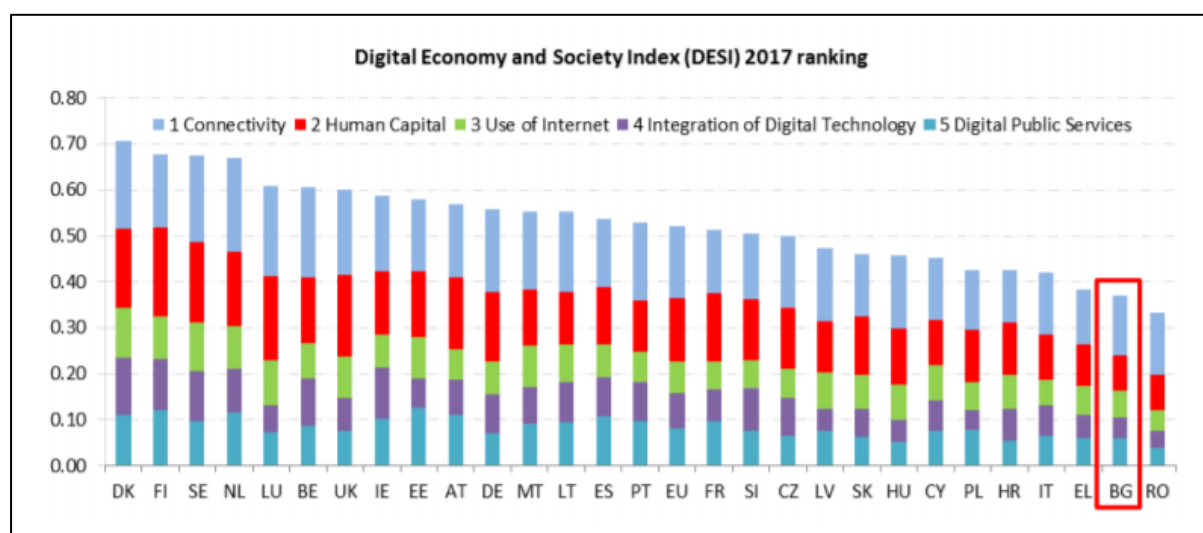
CHAPTER 4: BULGARIA and ICTs

4.1 Introduction

Bulgaria's information and communication technology (ICT) sector generated an annual turnover of over 5.5 billion leva (\$3.2 billion/2.8 billion euro) in 2018, an annual survey by local publisher Computerworld Bulgaria showed. In 2018 the revenues generated by Bulgarian companies developing software and applications for foreign and local clients jumped by 64% to 716 million leva. Bulgaria's software sector exceeded 950 million leva in 2018, as revenues from IT services alone generated over 3 billion leva, up by 45% from 2017.

Bulgaria ranks 27th in DESI 2017. Compared with 2016, Bulgaria progressed in the enhancement of its broadband infrastructure and in open data developments. However, its low performance in digital skills, digitisation of businesses and of public services are acting as a brake on the further development of Bulgaria's digital economy and society. Bulgaria belongs to the low performing cluster of countries (EDPR, 2017).

Figure 4.1.1 Digital Economy and Society Index ranking for Bulgaria 2017



Source: EDPR

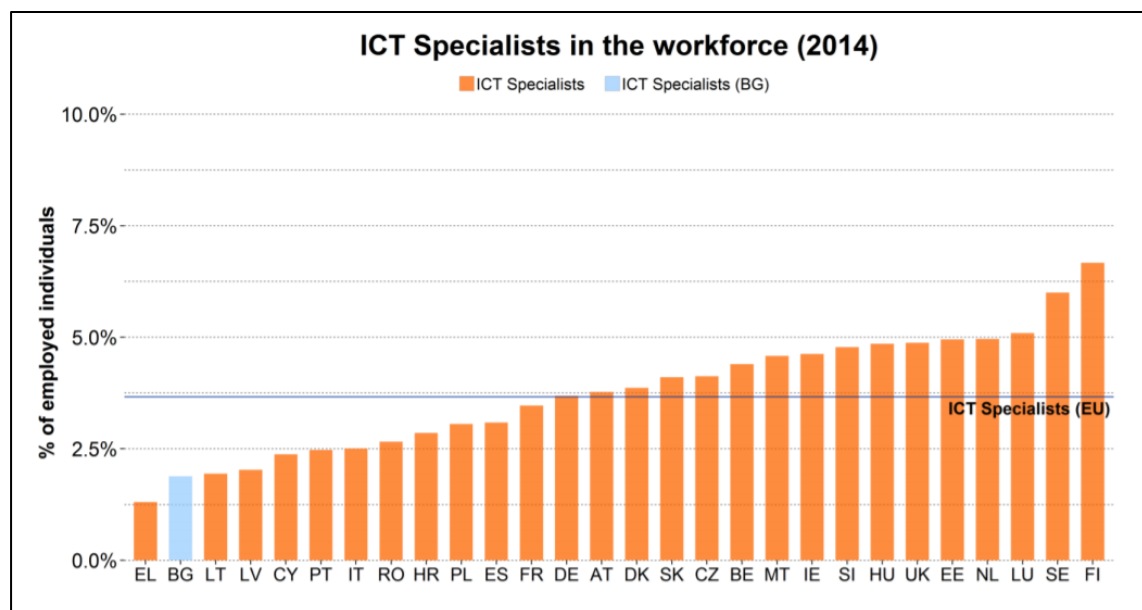
Bulgaria's performance is well below the EU average in the Integration of Digital Technologies by businesses. Bulgaria is an important user of RFID but is not managing to close the gap with the rest of the EU as regards business digitisation despite small improvements in the business use of social media, e-Invoices and cloud services. Particularly in e-Commerce, SMEs rarely sell online - only 5% of SMEs currently - and their turnover from online sales is low, only 1.7% of total turnover. This can be explained by the age gap: SME owners are often older than potential customers and lack the necessary skills to operate online.

A growing ecosystem of digital and tech entrepreneurs has emerged in the past years. In order to tap into the pool of highly qualified ICT specialists, many international companies have their IT offices in Bulgaria; but the overall economy is still not digitised. The Bulgarian Government has set up the Sofia Tech Park in an effort to encourage innovation but it only functions at half

of its capacity. According to Digital Scoreboard of 2016, In Bulgaria ICT Specialists account for 1.9% of the workforce (3.7% in the EU).

However, Bulgaria is also among EU member states where the share of ICT in the formation of the gross added value is relatively high, ranking the country 5th in the EU. The move towards cloud services, mobility and social business positively shaped Bulgaria's future IT landscape with an anticipated annual increase in IT expenditures of 4.2 percent in the next 5 years, boosted by an accelerated digital transformation spawned by Bulgaria's launch of the eGovernment State Agency.

Figure 4.1.2 ICT Specialists in the workforce (2014)

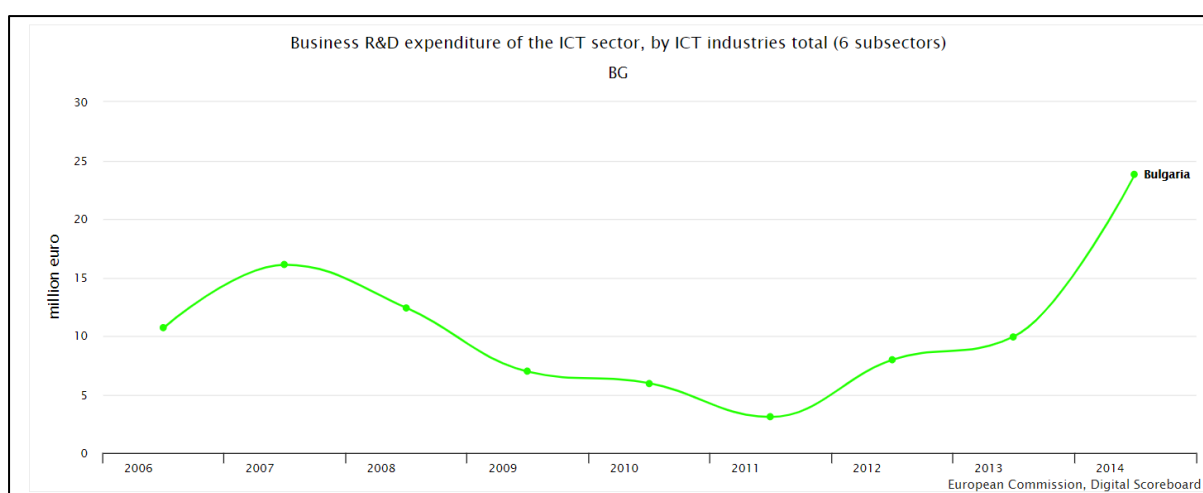


Source: Eurostat - Labour force survey.

Businesses in Bulgaria are adopting different digital technologies to enhance productivity, such as sharing internal information electronically or using RFID, eInvoicing, Social Media and Cloud. The figure below shows the R&D expenditure of the ICT sector, by ICT industries in Bulgaria of 6 subsectors which are:

- Manufacture of electronic components and boards.
- Manufacture of computers and peripheral equipment.
- Manufacture of communication equipment.
- Manufacture of consumer electronics.
- Computer and related activities.
- Telecommunications.

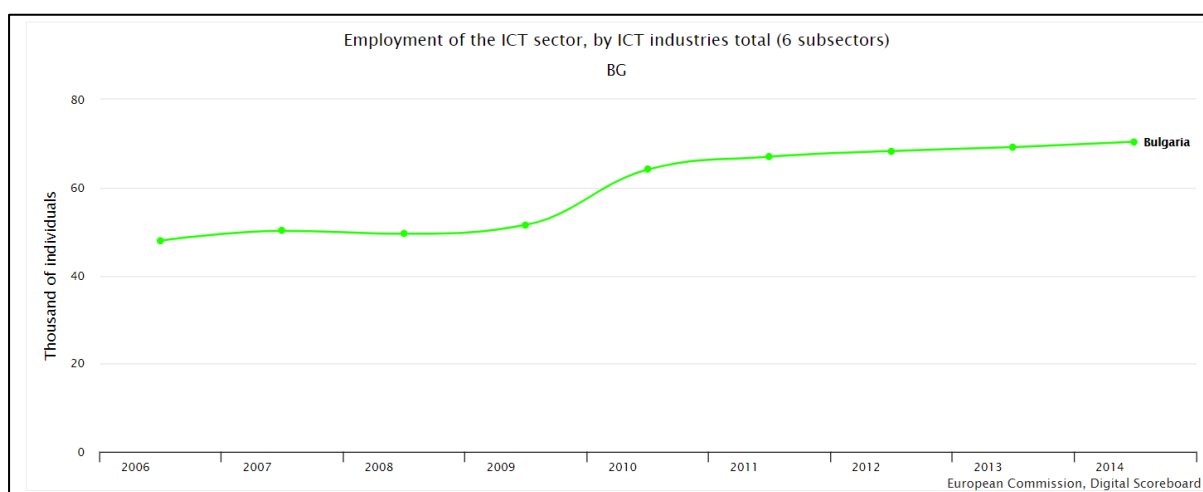
Figure 4.1.3 R&D expenditure of the ICT sector in Bulgaria



Source: <https://digital-agenda-data.eu/charts/>

Taking into consideration the previous subsectors of industries from 2006 to 2014 there is an increase of the employment of the ICT sector in Bulgaria.

Figure 4.1.4 Employment of the ICT sector in Bulgaria



Source: <https://digital-agenda-data.eu/charts/>

According to Eurostat, 70,000 people are employed in the ICT sector in Bulgaria, which is 2.3 percent of the total number of employees in the country. This is below the EU average of 3.5 percent. A highly-qualified IT specialist in Bulgaria earns \$20,000 per year which is two to three times more than the wages earned by the average Bulgarian.

4.2 Prospects

New opportunities exist in the ICT sector as Bulgarian companies work to increase their competitiveness in the EU, and as the Bulgarian Government complies with EU directives and legislation concerning its digital economy. As of July 2019, Bulgaria's

ICT sector is characterized as stable and constantly growing, making it one of the most profitable sectors in Bulgaria. In 2018 there were over 2000 important IT projects in Bulgaria.

Technology Sub-Sector Best Prospects Cloud technologies, Big Data, Internet of Things, and social media are growing technology segments. Emerging sub-sectors include cyber security, e-health, e-education, automotive electronics, intelligent transportation and smart city technologies.

Existing opportunities:

- Government tender opportunities exist for EU-mandated IT solutions to include: computers, peripherals, data centers, software, servers and other hardware technologies and integration services.
- E-Government Agency projects as described above.
- The national e-identification project of the Ministry of Interior.
- Government and private companies have undertaken various information and communication initiatives.
- EU funding under the Program for Rural Development and the EU Operational Program for Good Governance will provide funding for broadband access throughout Bulgaria, and other ICT projects.

4.3 Business Process Outsourcing

International ICT companies find Bulgaria attractive because of the 0 percent export tax, low operating costs and skilled local workforce. More and more foreign companies are opening global calls and service centers in Bulgaria as they move their operations out of India to Bulgaria, for example.

The four main pillars of Bulgaria's large outsourcing sector are:

- Geographic proximity to large European countries with no time zone issues.
- Availability of highly talented, multi-lingual individuals.
- Low labor costs.
- Favorable macro-economic and political environment.

4.4 The future

Nowadays Bulgaria has all 10 ICT-related sectors - grouped in 3 major areas - communication, hardware/electronics and software products & services. The total amount of the market is around 4 bln. Euros and is more or less equally distributed between those 3 areas. Just 10 years ago the distribution was mainly in benefit of the communication sector (almost 60%), followed by hardware (25%) and software (15%).

The Bulgarian software sector is very much expected to continue the internationalization but mainly on products/ innovation ideas development and not so much on pure services side anymore. International players have already realized

this trend and started to position their BG-based Labs as technology hubs rather than simple software factories - SAP Labs, Software AG, Nemetschek AG, DocuWare AG, Bosch AG and many more from Germany, HP, IBM, VMware, CSC, Johnson Controls from USA, as well as others from around the world. At the same time some Bulgarian companies are receiving venture funding and the first significant results are already visible.

The big hope is the vibrant start up community including spin-offs of existing mature companies. Cloud, mobile, social, big data, semantic, etc. are the common areas in which Bulgarian software companies have gained vast experience (TechUk, 2015).

CHAPTER 5: FORESIGHT STUDY METHODOLOGY AND RESULTS

5.1 Technology Foresight

Technology Foresight is an essentially important tool for long-term planning and planning at Regional, National or even International level. The TF, incorporating many different approaches to philosophy, benchmarking and tools used, is exploring the future to record trends and potential developments, but with the primary aim of improving and preparing today's decisions and strategic choices as best as possible.

Specifically, at the level of the Regions, which constitute an important administrative unit at European Union level, with sufficient size to carry out local policy, the European Commission in the Prospective Investigation Guide emphasizes the following: TF can enhance the planning of strategies and policies in regions, municipalities and communities. As knowledge of the developments that can shape the future is widely dispersed in societies, and as a result no organization has all the relevant knowledge, TF at the regional level emphasizes networking as a means of accessing such knowledge. As the future concerns us all, TF aims to promote the involvement of a larger proportion of the population or its key players in the creation of visions and the mobilization of collective strategic actions.

Figure 5.1.1: The 10 Most Common Technologies of Foresight in Europe



Source: EFMN

In our project the DELPHI technique is proposed in order to deliver TF. Delphi is a research methodology widely used in a wide range of disciplines. This method seeks

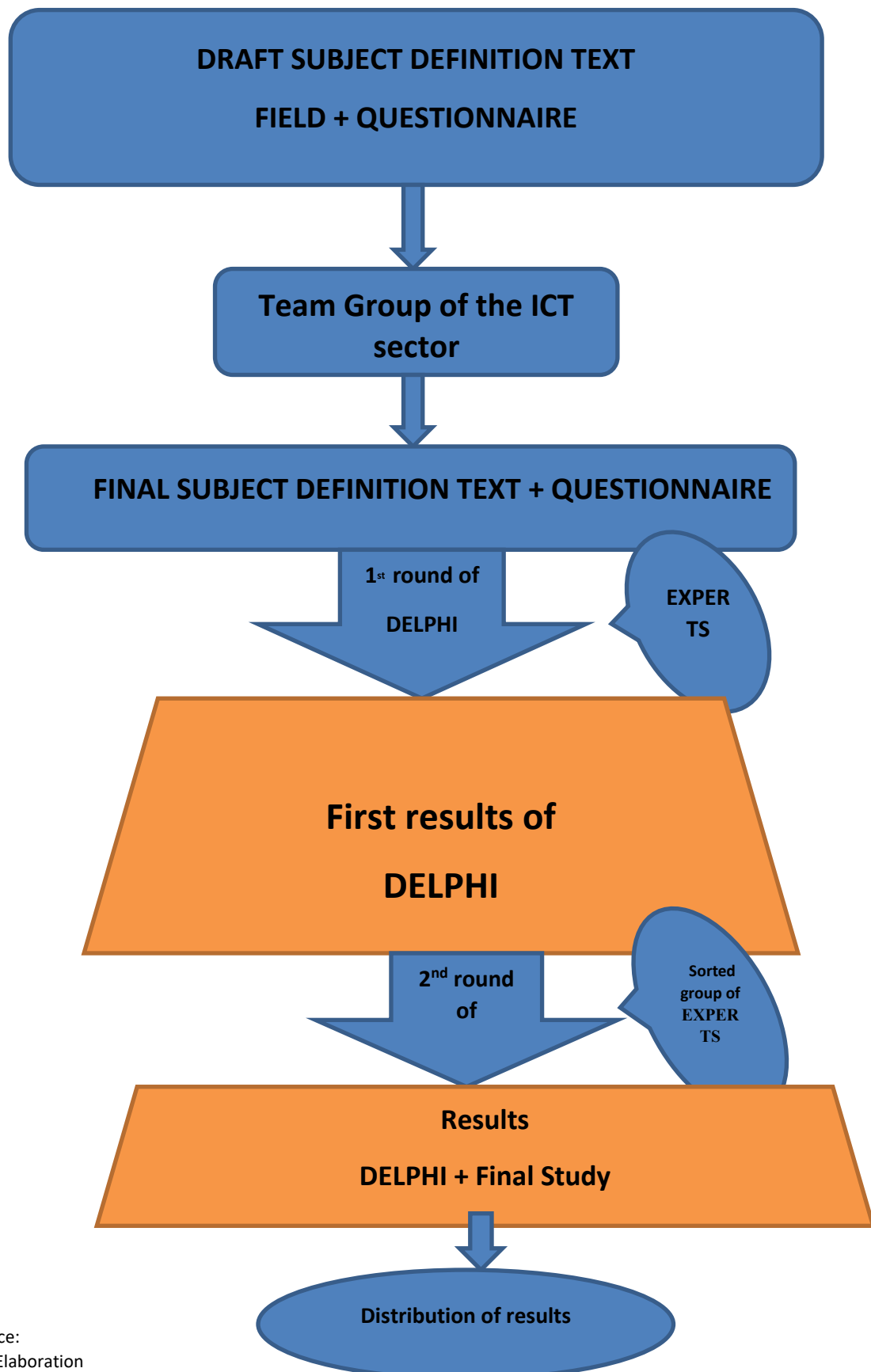
to obtain the maximum possible consensus of a pre-selected group of experts on a topic, by providing them with a series of consecutive questionnaires.

This technique is one of the most widely used predictive techniques and is therefore considered suitable for the development of innovative and development solutions where the effects of innovation will be long lasting and difficult to predict. The Delphi technique consists of the following phases:

- Phase one: describe the problem by sending a questionnaire to all team members,
- Phase two: analysis of responses while members are informed of average responses and asked to reconsider their responses. Members whose answers vary widely to explain their opinion (they may have additional information, their opinion is well founded or otherwise have an inaccurate opinion),
- Phase three: the analysis of the responses from the previous phase along with an explanation of the extreme positions are sent back to the participants who are asked to reconsider and send an answer.

The following figure is a diagram of the Prospective Technological Investigation with Delphi methodology.

Figure 5.1.2: Logical diagram of the Technological Foresight of Greece using Delphi methodology.



Source:
Self Elaboration

5.2 Questionnaire

For the final configuration of the statements, it was deemed necessary from the delimitation text and the methodological approach of the project, to request the opinion of representative local bodies of the private and public sector as well as individuals, with the method of questionnaires. The purpose of these questionnaires is to evaluate the proposed scenarios by stakeholders and individuals and to ask their opinion on the statement that they consider to be the most important. The results of the survey were then weighed using the weights corresponding to each level.

The form of the questionnaires was based on the following criteria:

- To be as comprehensible and understandable as possible by the respondent.
- To refer to all sectors of the industry under study.
- To be easy to process and quantify the data - answers.

The questionnaire, as shown in the Appendix, included each statement separately, with questions that were the same for all statements but had to be answered for each statement separately. The questionnaire, together with the initial baseline text and the implementation methodology, was distributed to a selected sample covering the entire spectrum of the Triple Helix in the under consideration area.

The Delphi survey was conducted in two rounds, via Internet, between experts representing different ICT entities or units directly involved in the field of ICT-related problems. In order to obtain a highly balanced sample, the exercise's supervisory board sought to ensure a high diversity of respondents in the area of know-how, the institutional framework as well as the homogeneity of the population.

Table 5.2.1 Selected experts in Round 1 and Round 2

Experts	Round 1	Round2
Business	$n_1 = 14$	$n_2 = 12$
Academics	$n_1 = 20$	$n_2 = 17$
Public bodies	$n_1 = 14$	$n_2 = 10$

Source: Self Elaboration

5.3 Delphi Statement Catalog

The ICT sector encompasses a diverse range of roles and skills. Thus, the questionnaire includes specific questions concerning the identification of gaps in ICT skills on 2 categories and 13 sectors:

Horizontal Sectors:

1. **Programming**
2. **Device, Network and Cloud Infrastructure**
3. **Cyber Security**
4. **ICT Business Change**
5. **Artificial Intelligence**
6. **Data Science**
7. **Web Services**

Vertical Sectors:

8. **E-learning**
9. **E-health care**
10. **E-government**
11. **E-payments**
12. **E-culture/tourism**
13. **Generating IT ancillary/soft/moderate skills**

*You can find the whole Delphi Statement Catalog in the Appendix

5.4 Results

The Delphi participants were provided with closed-ended, 5-point Likert scale questions in order to elicit the level of agreement with a series of statements regarding the relative importance of the various aspects of digital skills in ICT. Participants were asked to rate the categorised responses from Round 1 on a scale of 1 to 5, with 1 = Not important; 2 = Hardly important; 3 = Important; 4 = Quite important; and 5 = Totally important).

For this study, the analysis of consensus data of the experts was done based on median, inter quartile range and quartile deviation on the data of Round 1 and 2. After the definition of the median value, inter quartile range and quartile deviations, the subsequent analysis technique is to classify the items according to the consensus level and importance level.

Table 5.4.1 Consensus and importance levels

Quartile deviation (QD)	Level of consensus	Median	Level of importance
Less or equal to 0.5 ($QD \leq 0.5$)	High	More than or equal to 4 ($M \geq 4$)	High
More than 0.5 and less than or equal to 1.0 ($0.5 < QD \leq 1.0$)	Low	More than or equal to 4 ($M \geq 4$)	High
More than 0.5 and less than or equal to 1.0 ($0.5 < QD \leq 1$)	Low	Less than 4 ($M < 4$)	Low
Less or equal to 0.5 ($QD \leq 0.5$)	High	Less than 4 ($M < 4$)	Low

Source: Self Elaboration

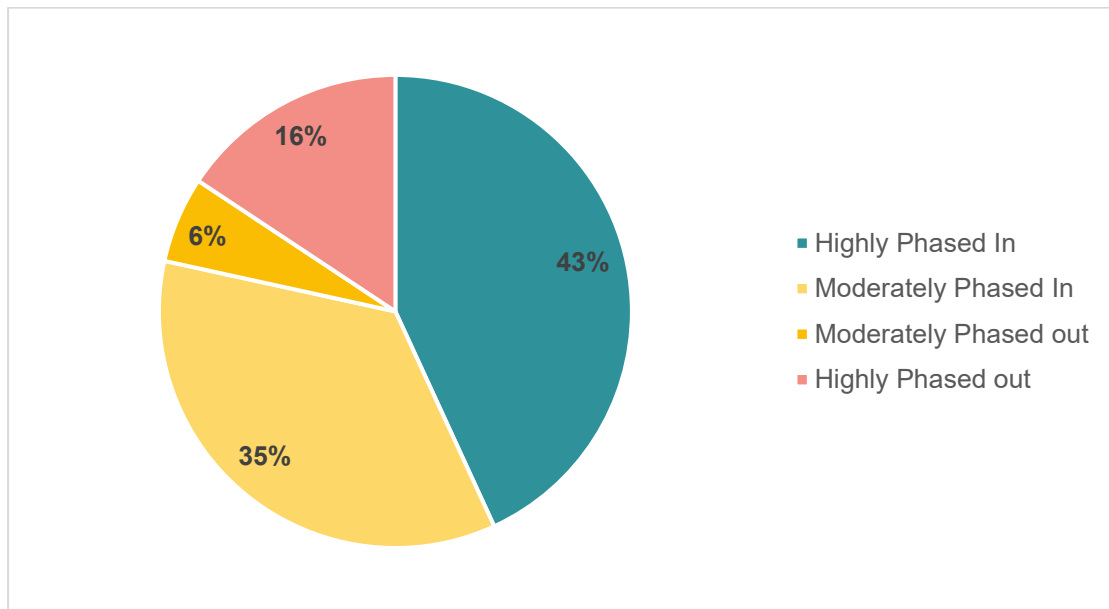
The responses for each statement needed to be classified in order to decide upon their eligibility into the next round. For this reason, the study gauged the median value and the quartile deviation (QD) as the reference metrics for the degree of importance and consensus. Four major categories were created in order to fit the responses and to decide if they were going to a second round.

Table 5.4.2 Classifications of responses

	Highly Phased In	$M \geq 4, QD \leq 0.5$	Keeping
	Moderately Phased In	$M \geq 4, 0.5 < QD \leq 1$	Keeping
	Moderately Phased Out	$M < 4, 0.5 < QD \leq 1$	Keeping
	Highly Phased Out	$M < 4, QD \leq 0.5$	Discarding

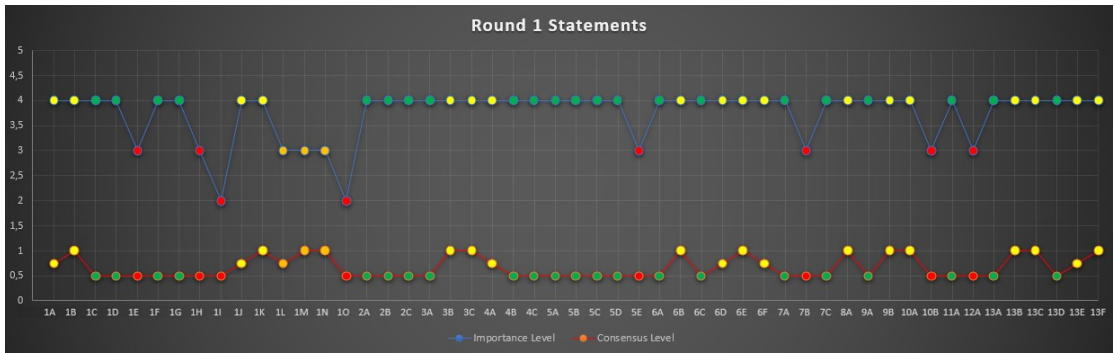
Source: Self Elaboration

Figure 5.4.1 Delphi Round 1 Results (Total)



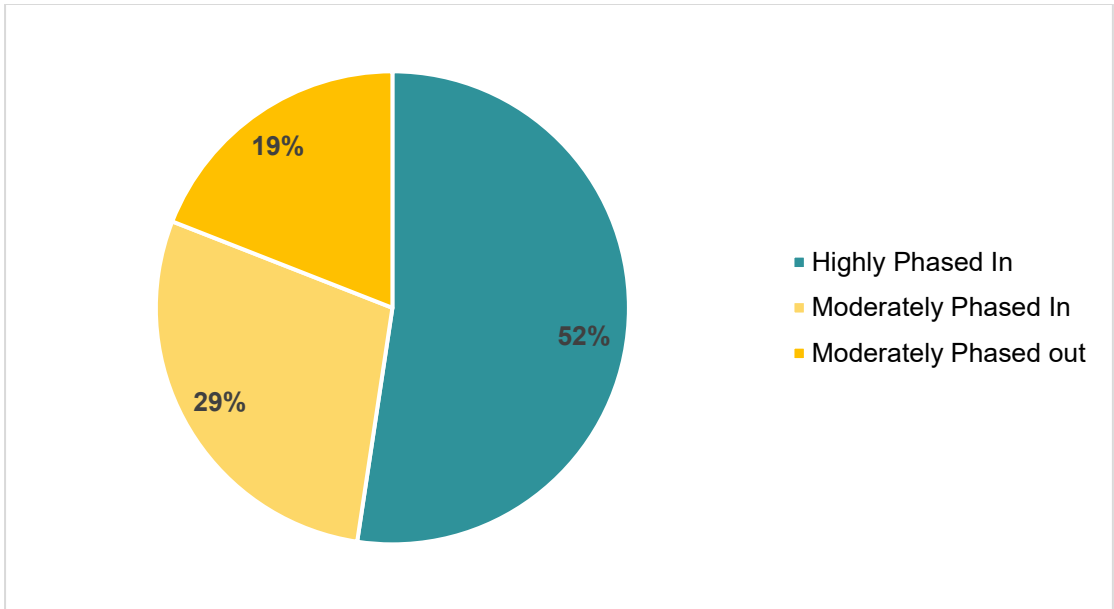
Source: Self Elaboration

Figure 5.4.2 Delphi Round 1 Results (Statements)



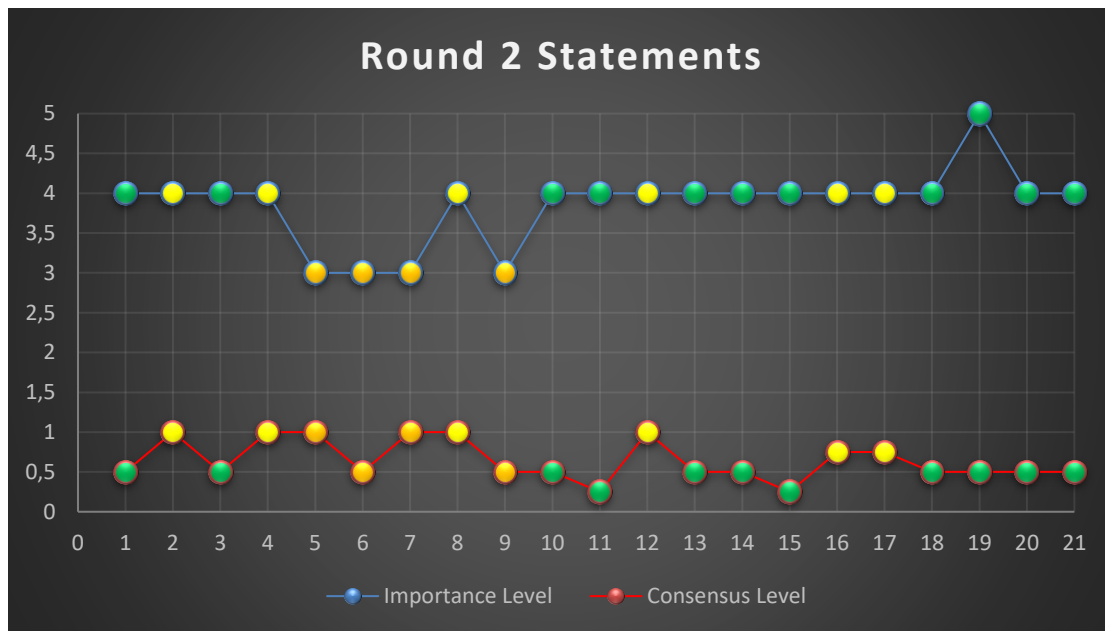
Source: Self Elaboration

Figure 5.4.3 Delphi Round 2 Results (Total)



Source: Self Elaboration

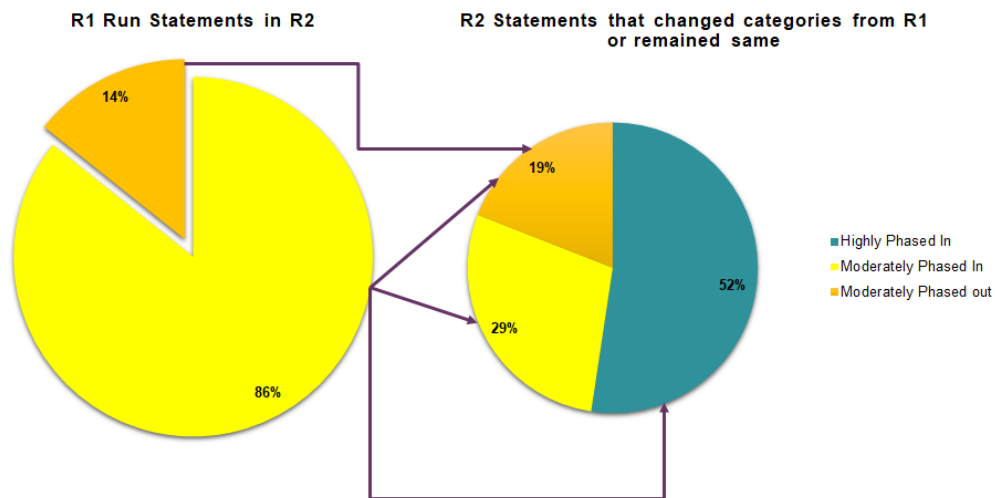
Figure 5.4.4 Delphi Round 2 Results (Statements)



1	1A. SQL
2	1B. JAVA
3	1J. PYTHON
4	1K. PHP
5	1L. OBJECTIVE C
6	1M. AJAX
7	1N. ASP.NET
8	3B. Communication security
9	3C. Quantum cryptography Expert
10	4A. ICT Business analyst
11	6B. Database Designer
12	6D. Big Data Modeling
13	6E. Data Analysis
14	6F. Data visualization
15	8A. Education and e-learning
16	9B. Advanced health monitoring system
17	10A. Digital Certificates Specialists
18	13B. Teamwork
19	13C. Communication
20	13E. Negotiation
21	13F. Technology Leadership

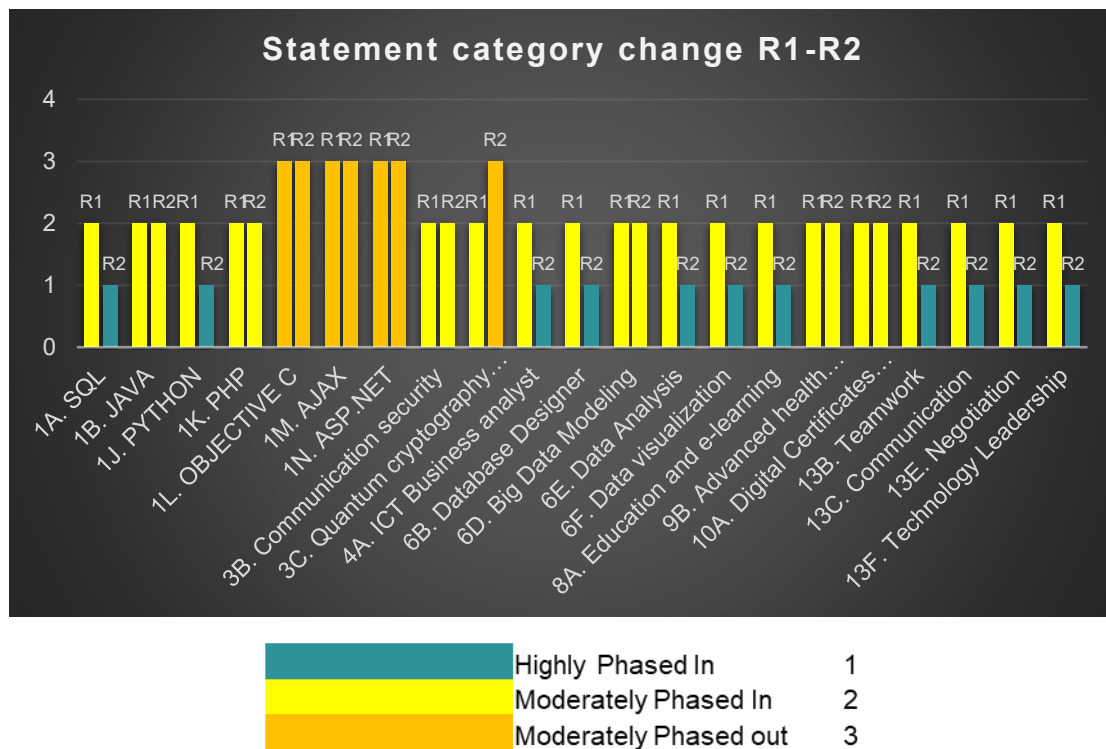
Source: Self Elaboration

Figure 5.4.5 R1 Run Statements in R2



Source: Self Elaboration

Figure 5.4.6 Statement category change R1-R2



Source: Self Elaboration

The Delphi results of the study are presented in the next Tables. In total 51 statements were carefully drafted and included in the first round. Statements of the Delphi questionnaire represented the broader categories as shown below of the horizontal and vertical sectors in ICT. For the second round 21 statements that did not achieve consensus on the first round were run again. Tables 5.4.3 - 5.4.5 present the statements found to be of high importance and achieved high consensus level in both Round 1 and Round 2. These are items that achieved quartile deviation (QD) value of less or equal to 0.5 with median of 4 and above. In total from both rounds 33 of the 51 statements reached consensus. For the purposes of this study it was decided not to run a third round since statements in the ‘‘Moderately phased In’’ and ‘‘Moderately Phased Out’’ category from the first round that remained the same in the second round would be highly unlikely to be changed in a third round.

Table 5.4.3 Delphi Results - Horizontal Sectors:
Programming, Infrastructure and Cyber Security

Horizontal Sectors	
Programming	Device, Network and Cloud Infrastructure
HTML	Device Management
JavaScript	Networking Hardware
XML	Cloud Computing Infrastructure
C#	Cyber Security
SQL	ICT Security Specialist
PYTHON	

Source: Self Elaboration

Table 5.4.4 Delphi Results- Horizontal Sectors:

Business Change, Artificial Intelligence, Data Science and Web services

Horizontal Sectors	
ICT Business Change	Artificial Intelligence
ICT Business Development Manager	Machine Learning
Business Intelligence	Automation in Robotics
ICT Business Analyst	Automated Reasoning
	Knowledge Representation
Data Science	Web services
Database Designer	Web Designer
Big Data Analytics	Web Development
Database Designer	
Data Analysis	
Data Visualization	

Source: Self Elaboration

Table 5.4.5 Delphi Results – Vertical Sectors:

E-learning, E-health care, E-payments and Generating IT skills

Vertical Sectors	
E-learning	Generating IT ancillary/soft/moderate skills
Education and e-learning	Problem Solving
E-health care	Self-Awareness
24-hour ICT-based care	Teamwork
E-payments	Communication
Mobile Phone Trading	Negotiation
	Technology Leadership

Source: Self Elaboration

Conclusion

The deliverable was focused on the analysis of the ICT sector and its trends worldwide, at a European level, as well as going on a country base analysis of the ICT sector in Greece, Cyprus and Bulgaria, analysing their current situation, opportunities, gaps and needs along with future prospects.

Focusing first on the European dimension the analysis found that Competitiveness, innovation and job creation in the European industry are being increasingly driven by the use of new information and communication technologies. This needs to be backed up by a workforce that has the knowledge and skills to apply these novel technologies efficiently. Given the transversal role of digital competences in the economy, a shortage of ICT specialists and workers with advanced ICT skills could hamper Europe's growth objectives. Digital transformation should be supported with a wide-range of actions on the governmental level. Europe's future competitiveness lies on its ability to stay relevant in areas that are the most likely to generate innovation and growth in the short term and this aim requires training and educating the digital workforce in the right direction.

As a next step the research was focused on finding the ICT status and situation of the partner countries under investigation for the project. Starting with Greece through an in-depth review identified the main critical occupations are emerging which in terms of knowledge, skills and competences that are linked to the ICT sector such as Mobile Applications Developer; Software Engineer (Developer); Systems Analyst/ Network Planner; Business Analyst; Digital Media Specialist and/or Web Master; Network Engineer and many other. Over the last 10 years the ICT labour market in Greece has been characterised by a rapid rate of occupational change, driven by the emergence of technologies requiring new skills and new ways of working. As a result, serious skills shortages have occurred. A possible solution is the provision of continuing training to employees to enhance the acquisition of new skills and new ways of working.

Subsequently an analysis for Cyprus and Bulgaria was conducted regarding their position in the ICT sector. Through the study it is indicated that Cypriot companies are beginning to see the strategic importance of infrastructure optimisation, consolidation, and transformation after some resistance to invest in ICT in recent years. As companies progress on their digital transformation journeys and inevitably require expertise in the implementation and utilisation of new technologies, they increasingly feel the effects of skills shortages, which we observed as a common issue with that of Greece.

Regarding Bulgaria it has a growing ecosystem of digital and tech entrepreneurs has emerged in the past years. Businesses in Bulgaria are adopting different digital technologies to enhance productivity, such as sharing internal information electronically or using RFID, eInvoicing, Social Media and Cloud. New opportunities exist in the ICT sector as Bulgarian companies work to increase their competitiveness in the EU, and as the Bulgarian Government complies with EU directives and legislation concerning its digital economy. As of July 2019, Bulgaria's ICT sector is characterized as stable and constantly growing, making it one of the most profitable sectors in Bulgaria. This opens new prospects for future developments and possible collaborations between know-how exchange and tackling common issues in the partner countries.

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ANNEX

1. Delphi Research Questionnaire

TECHNOLOGY FORESIGHT OF THE ICT SECTOR

DELPHI STATEMENT CATALOG

Perspectives and Opportunities of Information Technology

Delphi Research Questionnaire

pArtneRship foR AddressiNG mEgatrends in ICT

ARRANGE-ICT

June 2020

1. Methodology

Internet based research Delphi

2. Research Period

Phase 1:

Phase 2:

3. Interviews conducted

1st Phase: $n_1 = \dots\dots\dots$

(Percentage of answers ... %)

2nd Phase: $n_2 = \dots\dots\dots$

(Percentage of answers ... %)

4. Selection of experts

Representatives from business, academic community, public bodies and political representatives invited to participate in the research based on their specialization and experience in ICT.

5. Composition of the team of experts

Business	$n_1 = \dots\dots\dots$	$n_2 = \dots\dots\dots$
Academics	$n_1 = \dots\dots\dots$	$n_2 = \dots\dots\dots$
Public bodies	$n_1 = \dots\dots\dots$	$n_2 = \dots\dots\dots$

6. Questionnaire content

One of the fastest growing sectors in the business world, IT and technology provides an indispensable service to almost every industry, from fashion to finance. As a result, it's increasingly rare to find a company - big or small - without an IT department, which range in size from a handful of personnel to a hundred. Constantly evolving, the sector encompasses a diverse range of roles and skills, although these generally fall into 13 categories. The questionnaire includes specific questions concerning the identification of gaps in ICT skills on the following points:

Horizontal Sectors

1. Programming
2. Device, Network and Cloud Infrastructure
3. Cyber Security
4. ICT Business Change
5. Artificial Intelligence
6. Data Science
7. Web Services

Vertical Sectors

8. E-learning
9. E-health care
10. E-government
11. E-payments
12. E-culture/tourism
13. Generating IT ancillary/soft/moderate skills



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1.1 Delphi Statement Catalog

		<p>How important do you think the statement is? (X)</p> <p>(1 = not important; 2 = hardly important; 3 = important; 4 = quite important; 5 = totally important)</p>				
A/A	Statement	1	2	3	4	5
	Horizontal Sector	-	-	-	-	-
1	Programming	-	-	-	-	-
1A	SQL: the programming language for querying, manipulating and managing relational databases is in high demand					
1B	JAVA: the object-oriented language remains in heavy demand and used for a wide range of purposes					

1C	HTML: the skeleton of the Web for the foreseeable future					
1D	JavaScript: On the Web, JavaScript is what makes things interactive					
1E	C++: Like its predecessor C, C++ is used widely in operating systems, desktop apps, developing games, hardware drivers and much else					
1F	XML: The markup language is used to define structured information in a wide variety of contexts.					
1G	C#: Not to be confused with C or C++, C# is an object-oriented programming language developed by Microsoft in 2000 to compete with Java.					
1H	C: C has been around since the early 1970s and remains one of the most widely-used programming languages.					
1I	PERL: Perl was very popular in the 90s for its ability to create CGI scripts that beefed up the functionality of early Web pages.					
1J	PYTHON: Python is a general-purpose programming language that can be used in a variety of ways.					
1K	PHP: The open source, server-side scripting language runs on more than 20 million websites and powers high-profile sites					
1L	OBJECTIVE C: It's the core of development for both of Apple's operating systems.					
1M	AJAX: AJAX is actually multiple technologies bundled into one. Asynchronous JavaScript and XML was first popularized by Web applications like Google Maps and Gmail.					

1N	ASP.NET: Microsoft's server-side Web development framework is more controversial than many of its peers, in part because it's a Microsoft product.					
1O	RUBY: It may be almost 20 years old, but the object-oriented scripting language is still going strong.					
2	Device, Network and Cloud Infrastructure	-	-	-	-	-
2A	Device Management: Device management is the process of managing the implementation, operation and maintenance of a physical and/or virtual device.					
2B	Networking hardware: Also known as network equipment or computer networking devices, are electronic devices which are required for communication and interaction between devices on a computer network.					
2C	Cloud computing infrastructure: Cloud computing infrastructure is the collection of hardware and software elements needed to enable cloud computing. It includes computing power, networking, and storage, as well as an interface for users to access their virtualized resources.					
3	Cyber Security	-	-	-	-	-
3A	ICT security specialist: Peer-to-peer-based social networks and services are so important in the context of communication that businesses need to take security risks (e.g. by closing common security mechanisms, such as the firewall).					

3B	Communication security: Internet security problems have intensified so much that private and business communication via the internet has been severely reduced around the world.					
3C	Quantum cryptography Expert: Quantum cryptography is the technological basis of security systems.					
4	ICT Business Change	-	-	-	-	-
4A	ICT Business analyst: The analyst interacts with the business stakeholders and subject matter experts in order to understand their problems and needs.					
4B	ICT Business Development Manager: ICT business development managers increase business opportunities for the organisation and develop strategies					
4C	Business Intelligence: Business intelligence comprises the strategies and technologies used by enterprises for the data analysis of business information					
5	Artificial Intelligence	-	-	-	-	-
5A	Machine Learning: Machine learning is the study of computer algorithms that improve automatically through experience.					
5B	Automation in Robotics: Automation means using computer software, machines or other technology to carry out a task which would otherwise be done by a human worker.					
5C	Automated reasoning: Computers that use automated reasoning can be used to automate and apply logical reasoning to activities such as proving theorems, checking proofs etc.					

5D	Knowledge representation: Knowledge representation is all about understanding intelligence. Instead of trying to understand or build brains from the bottom up, its goal is to understand and build intelligent behavior from the top-down and focus on what an agent needs to know in order to behave intelligently.					
5E	Natural language processing: Natural language processing is the ability of a computer program to understand human language as it is spoken.					
6	Data Science	-	-	-	-	-
6A	Database Designer: Database administrators (DBAs) use specialized software to store and organize data.					
6B	Database Designer: The database designer is responsible for defining the detailed database design, including tables, indexes, views, constraints, triggers, stored procedures, and other database-specific constructs needed to store, retrieve, and delete persistent objects.					
6C	Big Data Analytics: Big Data analytics is the process of collecting, organizing and analyzing large sets of data (called Big Data) to discover patterns and other useful information.					
6D	Big Data Modeling: Data modeling is a complex science that involves organizing corporate data so it fits the needs of business processes.					
6E	Data Analysis: Data Analysis is the process of bringing order and structure to collected data.					
6F	Data visualization: Data visualization is the process of putting data into a chart, graph, or other visual format that helps inform analysis and interpretation.					

7	Web services	-	-	-	-	-
7A	Web Designer: A web designer is an IT professional who is responsible for designing the layout, visual appearance and the usability of a website.					
7B	Web Administrator: Website administrators are responsible for all aspects of keeping website content and design fresh, backed up, and fully functional.					
7C	Web development: Web development broadly refers to the tasks associated with developing websites for hosting via intranet or internet.					
Vertical Sectors		-	-	-	-	-
8	E-learning	-	-	-	-	-
8A	Education and e-learning: Education through lifelong learning concerns that the continuous increase in demand for ICT professionals will be covered.					
9	E-health care	-	-	-	-	-
9A	24-hour ICT-based care: The standard of medical care is to take care of people 24 hours a day (elderly, sick) in their own home using ICT systems.					
9B	Advanced health monitoring system: Complete recording of vital organs (pulse, blood pressure, blood sugar, etc.) on mobile devices, such as mobile phones, is widespread in the health system for preventive care or medical monitoring (e.g. for chronic diseases).					

10	E-government	-	-	-	-	-
10A	Digital Certificates Specialists: Through digital certificates, communication e-mails have become a legally binding model of communication.					
10B	Online elections services: Elections will be held online and do not depend on the actual ballots.					
11	E-payments	-	-	-	-	-
11A	Mobile Phone Trading: Technologies that make payment possible in stores / restaurants worldwide through mobile devices (e-wallet).					
12	E-culture/tourism	-	-	-	-	-
12A	Electronic Tourism and Culture: tele-service, online observatories: Electronic product management and promotion systems, digitization of cultural heritage, three-dimensional display, etc.					
13	Generating IT ancillary/soft/moderate skills	-	-	-	-	-
13A	Problem Solving: Solving problems isn't just reacting to those issues; it's thinking ahead and being proactive about what can go wrong and what needs fixing before there's a breakdown.					
13B	Teamwork: While IT professionals sometimes feel best working alone at their tasks, collaboration is a big part of the business world.					

13C	Communication: Presenting ideas and communicating a vision is imperative, as is listening and understanding what others tell.					
13D	Self-Awareness: Self-awareness is hard to teach, but there are effective ways to do it. In business situations, feedback is available through informal meetings with managers and formal job performance reviews.					
13E	Negotiation: Whether it's negotiating a salary or requesting a deadline extension, understanding the fine points of negotiation is an important skill to have as a manager and leader.					
13F	Technology Leadership: A leadership skill that requires both knowledge and vision of technology with the ability to envisage how technology might affect organizational dynamics.					

Please note any comments you may have:.....

Thank you for your participation!