Co-funded by the
Erasmus+ Programme
of the European Union

Industrial Internet of Things

BULGARIA GREECE SWEDEN CYPRUS ITALY LATVIA

Transnational report

Prepared By

IIoTNET team

May 2020

Co-funded by the
Erasmus+ Programme
of the European Union

This project has been funded with support from the European Commission. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Content

Introduction

The Fourth Industrial Revolution is transforming the labour market and the world of work in Europe and world-wide in many ways. Most pressingly so, by creating professional skills gaps and shortages and by digitalizing jobs performed by people until now. Digitalization transforms existing jobs, demanding new skills to carry out new tasks, which demands that the current work force has to be retrained or replaced by workers who already have these skills.

The blending of the digital, physical and biological worlds is constantly and exponentially changing all areas of human life and activity, not only with regard to jobs and the labour market, at large. It also influences economy at large, education, health, public administration, production and governance systems, the political and economic order of things.

In the field of employment, both the nature and conditions of work is changing and will continue to do so at an increased rate, since the application of robotics and artificial intelligence will remove most of the manual occupations. In addition, valid research has shown that in ten to fifteen years 60% of today's children under the age of 12 will be employed in professions we do not know today. At the same time, however, new professions will be created and those that require creativity, staffing, initiative, social interaction and emotional intelligence will be upgraded.

In the field of health, genomics, robotics, telemedicine and other new technologies have already yielded promising results in the early diagnosis of diseases, medical care and medication. At the same time, the analysis in less time, through artificial intelligence, of thousands of encephalograms and the detection of cancer tumours more accurately than those available by the best radiologists and oncologists will allow doctors to devote more time to treating patients.

In the field of education, new international technological developments, such as robotics and augmented reality, create the conditions for the development of both creative and critical thinking in children and young people. At the same time, innovative capabilities, such as automatic correction and grading in seconds, will give teachers more time for more meaningful and personalized teaching.

In the field of letters and arts it is now possible to preserve digitally the cultural heritage and to unhinder, by geographical and linguistic constraints, the diffusion of cultural goods throughout the length and breadth of the earth. In the supply chain, timely analysis of mass data offers opportunities for timely forecasting of new opportunities, as well as for identifying problems.

In the field of citizen-to-public communication, the digital transformation of the services offered can lead to the elimination of bureaucracy and the provision of excellent service to citizens, visitors and of public administration enterprises.

Undeniably, digitalization and the new emerging trends of the labour market come with a number of challenges, such as technological unemployment (with the implied risks of rising economic inequality), lack of regulation for new jobs and new markets, the quality and conditions of work, to name but a few. Taking into account the magnitude of the challenges faced by virtually all states, it is vital to lay solid foundation for cooperation in the digital transformation of the labour market.

As economic activity weakens (see the report below) and labour demand slows down, so too does the pressure among employers to make cost-saving structural changes. Technological developments through digitalisation, AI, and automation accelerate the development and lead to people no longer having the skills required. This is an area, as pointed out by various organisations, where this project can play a part in raising the level of awareness of Industrial Internet of Things.

The Transnational report is prepared with the aim of assessing the state of affairs with regard to IIoT in the six partner countries (Bulgaria, Greece, Sweden, Cyprus, Italy, and Latvia). This will form the basis for establishing an IIoT VET network, which, in turn, will help to promote the advancement of IIoT and the reaping of its benefits for all stakeholders. The report outlines the IIoT diffusion at national and European level. It presents identified professional skills required in the area of IIoT and an analysis of the labour market actual situation and prospective of employability. Publication of this transnational report will support SMEs in meeting the demands with clear overview of today's SME situation in Europe in relation to Industry 4.0 in particular IIoT technologies.

It needs to be noted, however, that all forecasts included in this report pre-date the current state of affairs in the world with regard to effects caused by the pandemic. It is quite likely that those forecasts will shift, creating opportunities where there were none before, and increasing the weight of the problems already expected.

The report has four parts, it contains 8 Tables and 48 Figures, and it includes 1 Annexe.

1. DIGITAL TRANSFORMATION AND EMERGING TRENDS OF LABOUR MARKET IN SIX EU PARTNER COUNTRIES

Over the last 10 years, the pace of the environment we live in has incredibly accelerated. This is especially true when it comes to ICT.

The fourth industrial revolution is transforming the labour market by demanding new professional skills and by digitalizing jobs done by the human resources of companies. The labour market is the most important resource in the business environment. The employee is one of the main resources, the quality of which determines the quality of the company's goods and services. Digitalization transforms existing jobs, demanding new skills to carry out new tasks, which may imply that the current work force has to be retrained or replaced by workers who already have these skills. There are several studies that estimate job creation and destruction resulting from digitalization in traditional businesses and industries. Digital skills will be in high demand in the labour markets of the future, as will entrepreneurial skills and creativity.

The current technological transformation, based on the interweaving of digitalization and automation of socio-economic relations, is also creating profound changes in the world of work. The challenges facing the world of work in Europe (and also, in the world) concern the risk of technological unemployment; the quality and conditions of work, with the effects that automation can have on the control and reorganization of times and procedures for task execution; the risk of rising levels of economic inequality, with the more highly qualified workers seeing an increase in employment opportunities and income conditions at the expense of those employed in lower-skilled jobs; the rise of new jobs and new markets characterized by the absence of regulations that can guarantee adequate rights and protection as well as the proper appreciation of work. It can be expected that a shift in the unemployment rates will happen, and it is crucial to ensure that the shift happens towards to decrease of unemployment, not an increase.

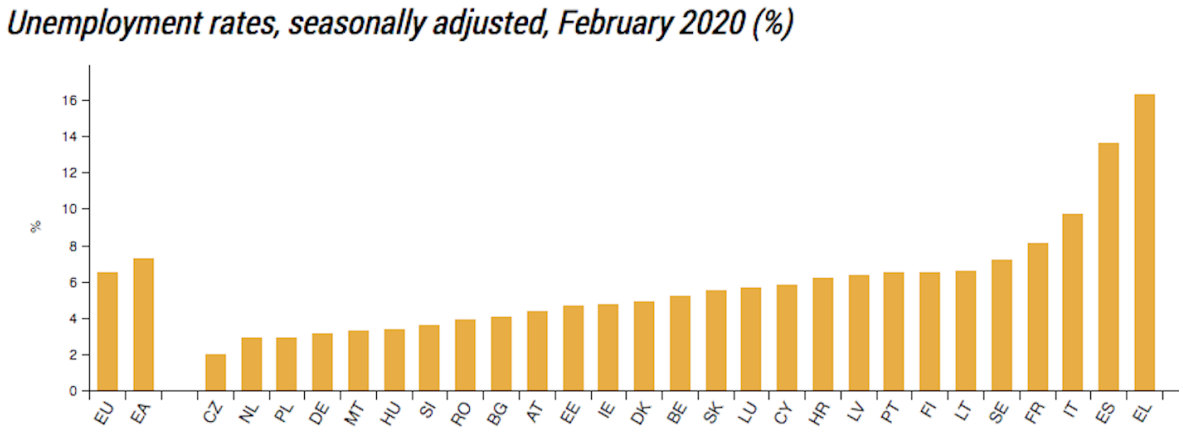


Figure 1 Eurostat unemployment rates, February 2020 (source: Eurostat)

These risks come in addition to a series of crucial challenges that the European economy and world of work are confronted with, such as the ageing of the population, the need to reduce gender disparity in the labour market, territorial imbalances and the necessity to ensure the sustainable internationalization of economic relations.

At the same time, new technologies provide important opportunities of increasing quality employment, of improving the safety of production processes, of stimulating start-ups and fostering youth employment. [1]

Digitalisation has a strong impact on enterprises, both in manufacturing and services industries, where converging trends are detectable in the way micro, small and medium-sized enterprises interact with customers and employees. The main factors for successful adaptation are the ability to collect and exploit data, the interconnection of value chains, and the creation of digital customer interfaces and mitigation of cyber threats. [2]

In the following chapter, the criteria that have the most impact on labour market trends is analysed. A further aim of the chapter is to postulate on new professions which will, in the future, be in high demand and the skills that will be required to fulfil those job non-robotized profiles. Analyses is based on the experience of six EU partner countries to this project—Bulgaria, Greece, Sweden, Cyprus, Italy, and Latvia.

1.1. ANALYSIS OF THE LABOUR MARKET

1.1.1. Bulgaria

In the third quarter of 2019, the number of people employed by the age 15 and over, increased by 93.9 thousand compared to the third quarter of 2018; their number was 3299.2 thousand. Compared to the second quarter of 2019, the reported increase was 36.4 thousand. Employment rate for the population of age 15-64 was 71.4%; compared to the third quarter of 2018, it increased by 2.6 percentage points (pp). The coefficient of employment for the 20-64 age group is 76.3% - 2.8 pp higher than in the third quarter of 2018. Among economic activities with largest increase in the number of employees of age 15 and over, through third quarter of 2019 (compared to the same the period of 2018) were “Processing industry" (by 14.8 thousand); "Transport and warehousing" (by 12.6 thousand); and “Trade”. The number of unemployed decreased by 42.9 thousand compared to the third quarter of 2018 and reached 125.4 thousand, which was the lowest value reached since 2003. The coefficient of the unemployment rate was 3.7%, with 1.3 pp lower than in the third quarter of 2018.

1 For example, see “The Changing world of work – Digitalization, automation and the future of work” (Italian Ministry of Labour and Social Policies).
2 Impact of digitalization and the on-demand economy on labour markets and the consequences for employment and industrial relations (European Economic and Social Committee).

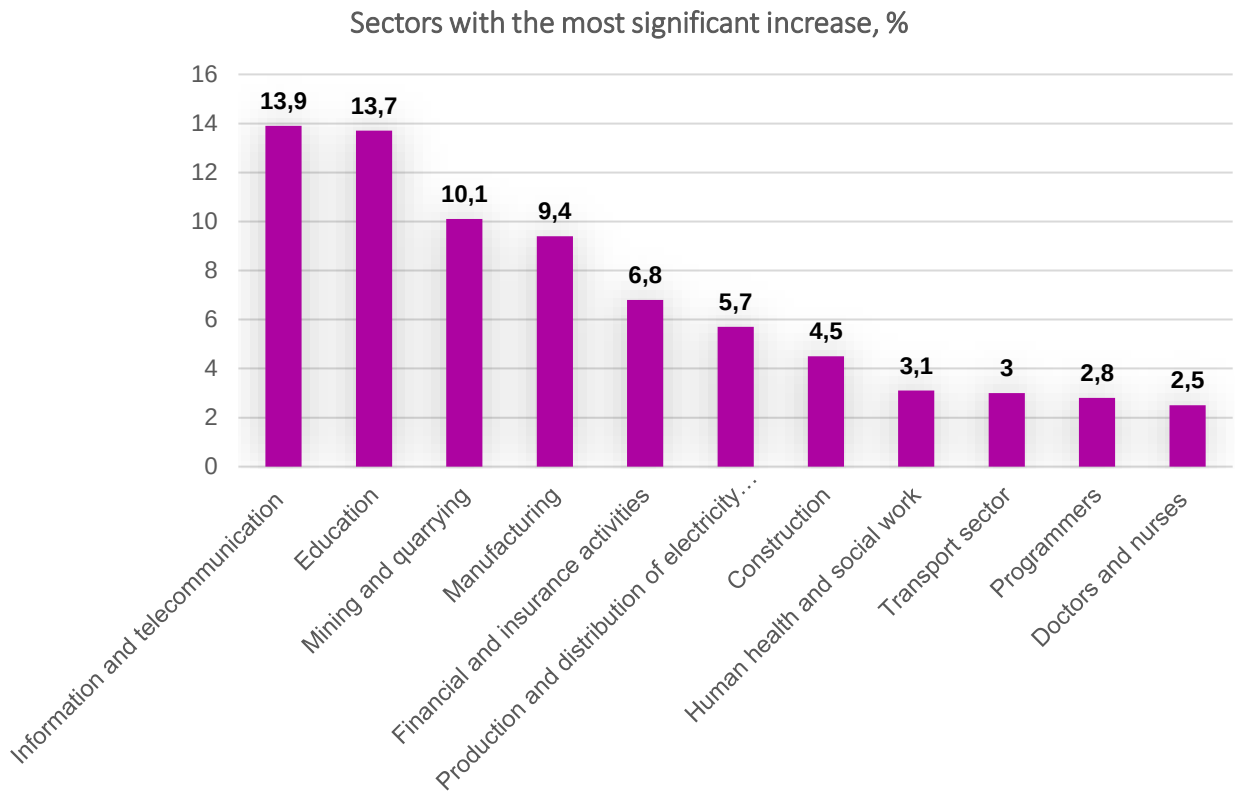


Figure 2 Sectors with the most significant increase

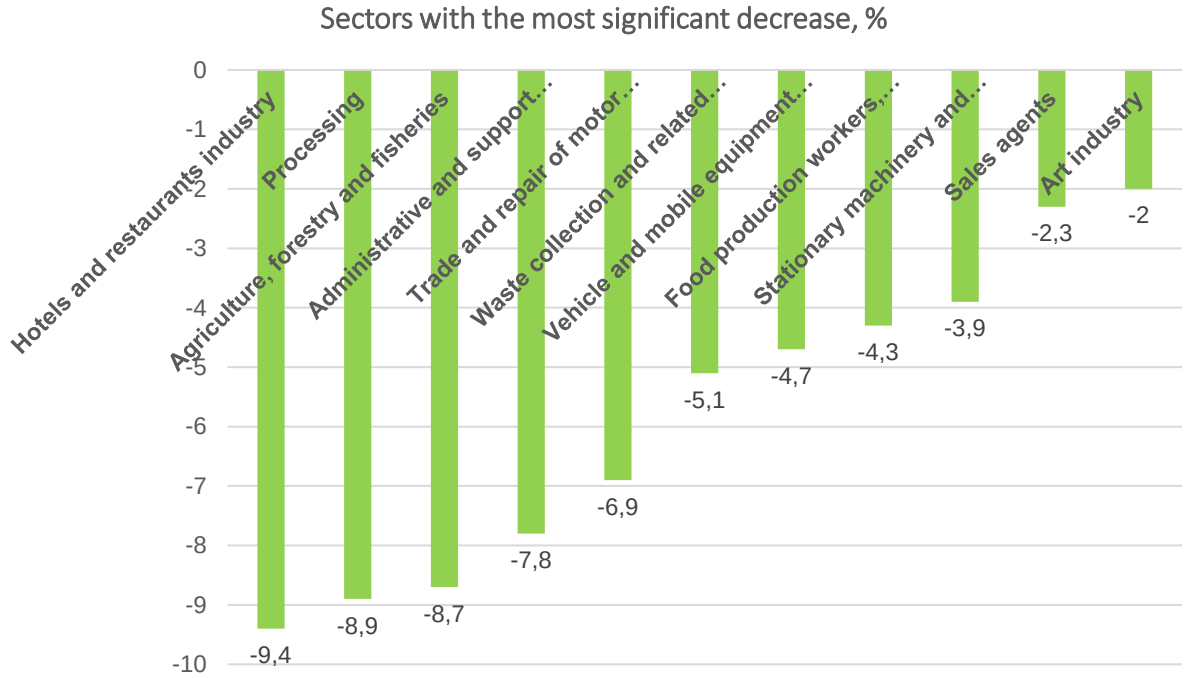


Figure 3 Sectors with the most significant decrease

Currently, the Bulgarian business sector also needs another 70,144 specialists with higher education: teachers, drivers, nurses, doctors and mechanical engineers. In addition, across all sectors of the economy over the next year 77,710 non-specialist workers will be required. 8 out of 10 employers have stated that the main form of employment they will provide over the next year will be on a permanent contract and full-time. Employers have declared the need for nearly 327,000 workers and specialists over the year, of which just over 179,000 are specialists and skilled workers. Those most wanted are: workers in the food industry, machine operators, builders, security guards, woodworkers, construction contractors, cooks, etc.

More than 78% of employers in the country face difficulties in securing personnel, with the most serious difficulties in finding machine operators, programmers, and builders. In the medium term, in 3-5 years, more than 22,500 IT professionals and more economists will be needed in the Bulgarian business. The sector that will be looking for the most specialists with higher education in the next 3 to 5 years remains "Government, education, humanitarian health" with 22% of all stated needs or 48,391 people in total.

In the industry, the demand for computer science, economics, administration and management is about the same. The demand for specialists will continue to rise, most notably in the wholesale and retail trade, reaching 52,297 in the following years.

1.1.2. GREECE

Greek economy, hit severely by the 2009 financial crisis, has only recently begun to recover from a long and deep recession. According to the latest European Economic Forecast[3], the economy is estimated to have grown by 2.2% in 2019 and is expected to grow at or above 2% by 2021. Real GDP in Greece is forecasted to reach 2.4% in 2020 and 2% in 2021. The 2020 National Budget projects investment and consumption to be the main drivers of growth. [4]

The country has the highest unemployment rate in the EU, although since its peak of 27.9% in September 2013 unemployment has been steadily decreasing. According to Eurostat, Greece experienced the largest decrease in the EU in the past year, with the rate falling to 16.3 % in December 2019 down from 18.5 % a year ago. [5]

Despite recent improvements, women's labour market participation lags far behind the EU average, long-term unemployment is a serious concern and youth unemployment rate was 34.7%

3 European Commission (2020) *European Economic Forecast, Winter 2020 (Interim)*, Institutional Paper 121, February 2020, Brussels, pp. 15-16, available at: https://ec.europa.eu/info/publications/european-economic-forecast-winter-2020_en (last accessed 3.4.2020). The report was published before the coronavirus outbreak in Europe and the new economic reality it brings.

4 Ministry of Finance (2019*) 2020 Budget Report submitted to the Greek Parliament* (in Greek), available at https://www.minfin.gr/proupologismos/-/asset_publisher/qmvb5pyzdGAQ/content/kratikos-proupologismos-2020?inheritRedirect=false (last accessed 3.4.2020)

5 Eurostat unemployment statistics (February 2020), available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Unemployment_statistics (last accessed 3.4.2020)

in December 2019, the highest in the EU. [6] The labour market integration of people with a migrant background is also a challenge. Non-EU nationals legally residing in Greece represented 5.6% of the population in 2017 (above the EU average of 4.2%), and their employment rate is structurally lower than that of Greek nationals. [7]

A more pronounced recovery in employment has been taking place since the end of 2016. There has been job creation in all sectors of the economy, with larger absolute gains in the tradable services sector (which accounts for one third of the Greek economy), but a relatively stronger growth in industry and construction, i.e. the sectors which had registered the largest job losses throughout the crisis. [8] In the same year, CEDEFOP's Skills Panorama[9] identified a number of occupations as **mismatch priority occupations for Greece**, i.e. they are either in shortage of surplus (Table 1).

Table 1

Mismatch priority occupations in Greece (source: CEDEFOP Skills Panorama)

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, cabinet-makers and related trades workers
	Painters, building structure cleaners and related trades workers

Concerning mismatches in ICT, Greece has the lowest share of ICT specialists in total employment in the EU: 1.6 % in 2017, compared with an EU average of 3.7 %, although there has been some slight progress in the last three years. [10] A significant gender gap is also observed with only 10.9 % of employed people in the ICT sector being women. The overall proportion of ICT graduates in the total pool of graduates is at 3.2 %, below the EU average.

6 Ibid.
7 European Commission (2019) *Country Report Greece*, Commission Staff Working Document SWD(2019) 1007 final, Brussels 27.2.2019, accompanying the European Commission Communication 'European Semester: Assessment of progress on structural reforms, prevention and correction of macroeconomic imbalances, and results of in-depth reviews under Regulation (EU) No 1176/2011', available at https://ec.europa.eu/info/sites/info/files/file_import/2019-european-semester-country-report-greece_en.pdf
8 European Commission (2019) *Country Report Greece*, op.cit. pg. 29.
9 CEDEFOP (2016) *Greece: Mismatch priority occupations*, CEDEFOP Skills Panorama available at: https://skillspanorama.cedefop.europa.eu/en/analytical_highlights/greece-mismatch-priority-occupations (last accessed 3.4.2020)
10 European Commission (2019) *Digital Economy and Society Index (DESI) 2019 Country Report Greece*, pg. 7, available at https://ec.europa.eu/digital-single-market/en/desi (last accessed 3.4.2020).

During the ten-year long recession, Greece has experienced an extensive brain drain [11] that has had a strong negative impact on the size and quality of the domestic labour force and has exacerbated the skills mismatch. Between 2008 and 2017, more than 467,000 young scientists and professionals aged 24-44 migrated, mainly to other EU countries. [12] According to the Bank of Greece, "the reversal of this phenomenon into a brain regain calls for the formulation and credible implementation of a comprehensive national growth strategy, based on a thorough analysis of sectors of production, aimed at identifying the hard and soft skills most in demand". [13]

In the upcoming years, strengthening the investment activity will be instrumental in underpinning longer-term growth. Key public and private sector sectorial investment priorities include:

- transport and logistics,
- sustainable regeneration of urban and most disadvantaged and deprived areas,
- energy efficiency and infrastructures,
- environmental protection,
- digital technologies,
- employment, skills, education and training, social inclusion and integration
- health and
- R&D, mainly through the development of smart specialisation strategies in sectors such as agro-food and tourism.

Greece is the least open country in the EU in terms of investments and trade flows, despite its small size and favourable geographic position. Tourism is a key contributor to exports and a vital driver for the Greek economy and together with trade in services have led the economic recovery, weakly supported by agriculture, manufacturing and, most recently, a pick-up in construction[14] (figure 2). Investments into information and communication technology (ICT) and infrastructures are particularly needed for Greece to catch up with the other EU countries and make up for the investment slump during the crisis. Insufficient higher-speed broadband connectivity has been identified as a major bottleneck for dynamic export-oriented businesses. According to the DESI 2019 Report, Greece ranks 22nd among EU countries on the Integration of digital technology by businesses, which is well below the EU average[15].

11 To reverse this trend the Ministry of Labour and Social Affairs recently announced the "Re-brain Greece" programme.
12 Bank of Greece (2019) *Interim Report on Monetary Policy 2019*, Athens: Bank of Greece (in Greek), pg. 109. Available at https://www.bankofgreece.gr/Publications/Inter_NomPol2019.pdf (last accessed 3.4.2020)
13 Ibid.
14 IMF (2019) Greece - Staff Report for the 2019 Article IV Consultation, available at https://www.imf.org/en/Publications/CR/Issues/2019/11/14/Greece-2019-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-48806 (last accessed 3.5.2020)
15 European Commission (2019) *Digital Economy and Society Index*, op. cit. pg. 10.

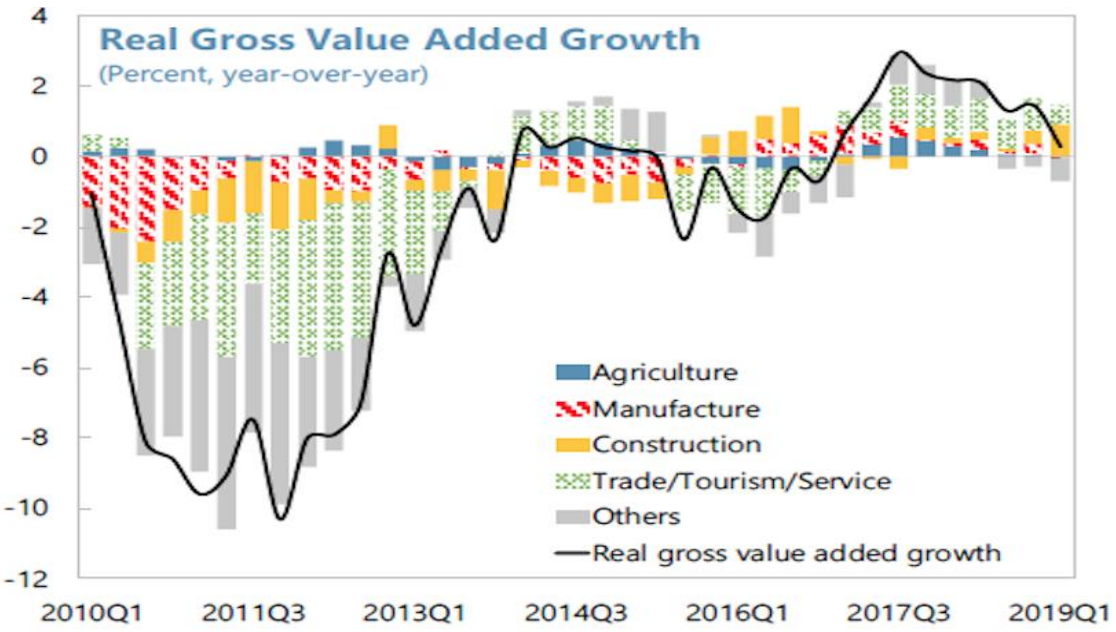


Figure 4 Growth per economy sector 2010-2019 (source: IMF 2019)

1.1.3. SWEDEN

According to Eurostat, unemployment in Sweden was 6.9 percent of the labour force in December 2019. This is higher than the EU-28 average, where the unemployment rate was 6.2%. Only five EU countries had higher unemployment at that time.

To give a comparative view of the labour market situation in Sweden, it is perhaps useful to set off the national rates and numbers against regional numbers and rates. For the sake of simplicity, the report includes, where appropriate, comparative rates from the Swedish partner's place of residence, the Gävleborg County. Looking at the proportion of people registered with the Employment Service and looking for a job or participating in a labour market unemployment program, it can be noted that, for instance, in December 2019, this share was 7.4 percent of the labour force (register-based labour) and had increased by 0.4 percentage points since the corresponding period of last year. In the Gävleborg County, the share of enrolments in the Public Employment Service in was 10.1 percent and had increased by 0.7 percentage points, compared to December 2018.

The unemployment rate among young people (aged 18-24) was 9.2% of the labour force (7.4% for girls and 10.9% for boys) and had increased by 0.7 percentage points in the corresponding month of the previous year. In Gävleborg County, youth unemployment was 14.7% of the labour force (12.2% for girls and 16.8% for boys) and had increased by 0.5 percent.

Sweden has a very high participation in employment. In the chart below, Sweden's line is the top one. Employment 20-64 years (note the age range!) is the highest in the EU and it has never been as high as it is now in this millennium.

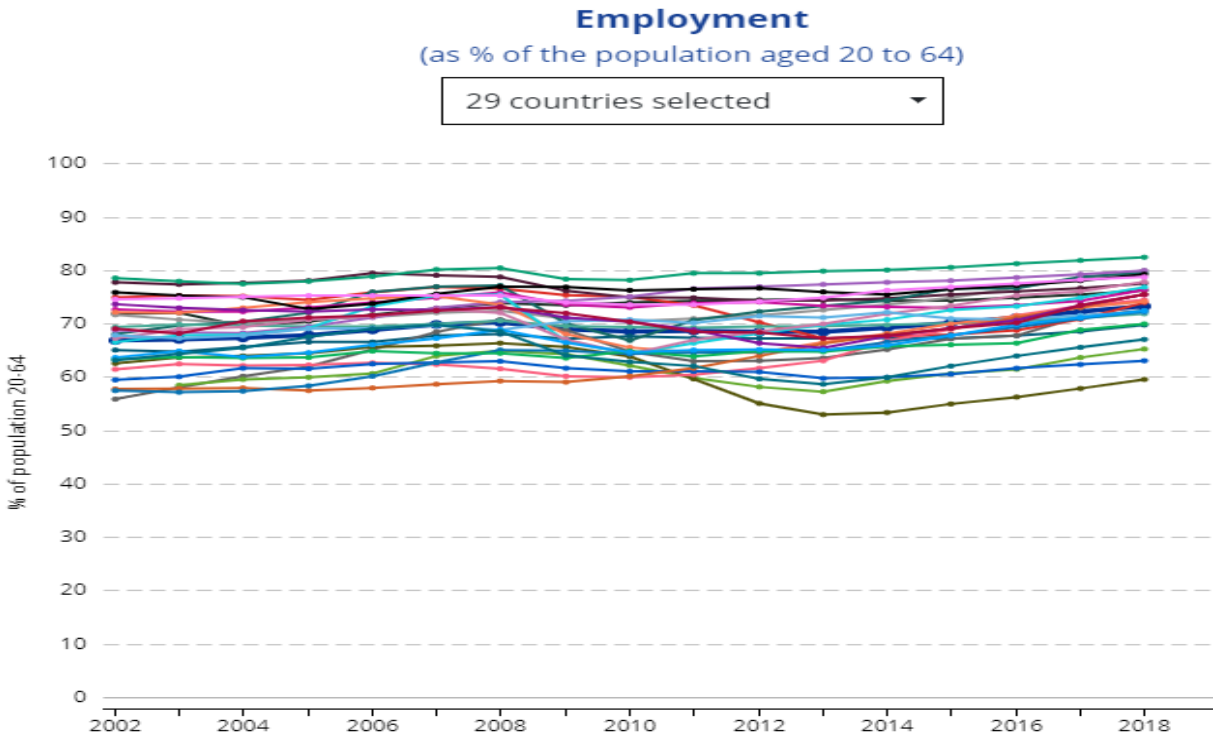


Figure 5 Employment rates

Regionally, statistics in Sweden measures employment in the age range 15-74 years. For obvious reasons, therefore, the employment rate is lower as a large proportion of young people do not get jobs but are in education until they are 27 years old.

In Sweden, the employment rate for the population 4 2019 was 68.2 percent. As in all EU countries, the proportion of employed women is lower, 66.1% compared to men's 70.2%. Gävleborg County's employment rate was, in Q.4 2019, 63.8% (62% for women and 70.2% for men). Of the 21 counties Sweden, only three counties had a lower employment rate.

Over the past five years, an increasing shortage of skills has been signalled by employers. First, this has included professions requiring higher education, such as doctors, nurses with specialist skills, engineers, and teachers. In recent years, skills shortages have also included occupations requiring a secondary education.

In 2011, Sweden implemented a high school reform. It meant a sharp decrease in the number of students in the upper secondary vocational educations. The table below are the strategic shortage occupations that we are working on in Region Gävleborg in 2019. They are largely in line with those professions that are shortage occupations nationally.

Table 2

Strategic Shortage Occupations 2019			
University	**University**	**Polytechnic**	**Upper secondary**
automation engineer	subject teachers	building permit officer	chef
biomedical analyst	physician	construction foreman	truck mechanic
building engineer	specialist nurse	data it technician	machine operator
civil engineer material design	machine engineer	electrical engineer	building trades
electrical power engineer	police	medical secretary	electrician
engineer data and electronics	accountant	accountant	vehicle mechanic
social worker	nurse	nursing specialist	waiter/head waiter
teacher	system developers IT	purchaser	assistant nurse
vocational teacher		wind power technician	truck driver
		plumbing engineer	

The labour market varies a lot in Sweden, depending on the location. The main centres for economic growth are the large cities and the cities with universities. The rural areas have a slower economic growth in general. Industries in rural areas are undergoing a structural transformation with focus on automatization and digitalisation and the consequence is that there is the need for fewer employees with higher level of education.

The Swedish Public Employment Service forecast for 2019 and 2021 indicates a continued strong labour market. At the same time, the slowdown in the economy is becoming increasingly clear. In total, the number of employed persons increased by 45,000, which is a dampening compared with previous years.

In 2019, employment increased by 27,000 people and by 2020 the number was expected to increase by 19,000, which is a write-down compared to previous forecasts. However, these are outdated forecasts now and the unemployment rate is raising during Covid-19 pandemic.

In 2020, the Employment Service estimates that unemployment will rise from 6.8 percent in 2019 to 7.2 percent. In 2021, unemployment is estimated to reach 7.4 percent but this remains to be seen now as the effects of the pandemic will start to settle in.

The biggest challenge for Sweden in the coming years is the rising long-term unemployment as the number of unemployed people who have been unemployed for more than twelve months is increasing. In addition to a weaker demand for labour, the lack of demand for skills among the unemployed also contributes. The negative development has mainly affected foreign-born women with a lower level education.

1.1.4. CYPRUS

The recent financial crisis has had a significant negative impact on the Cyprus labour market with the contraction of employment and rising unemployment, affecting mainly population groups such as young people and the elderly. The economy has returned to increasing growth rates since 2015 which have led to increased employment and reduced unemployment. [16]

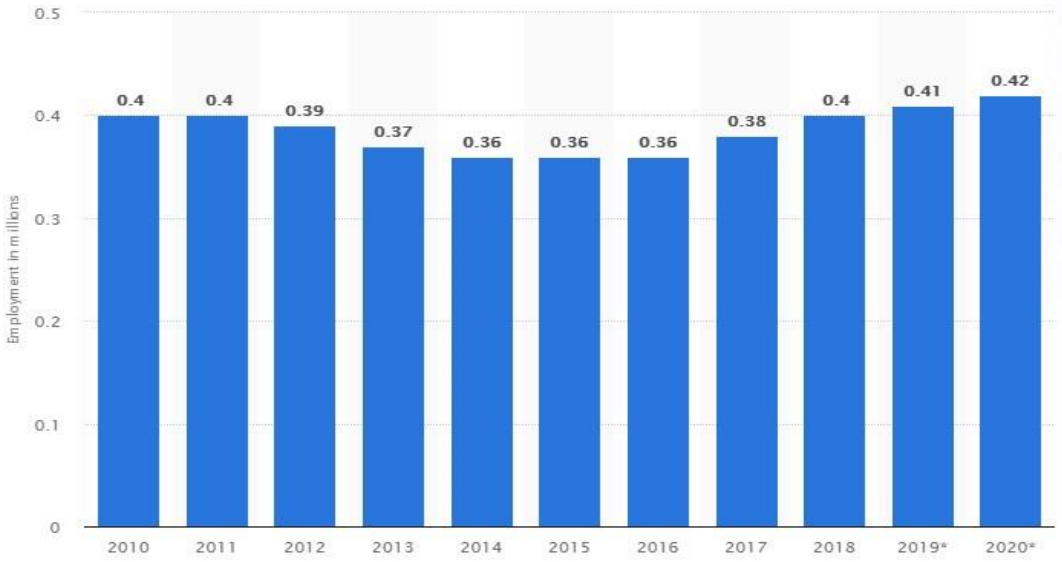
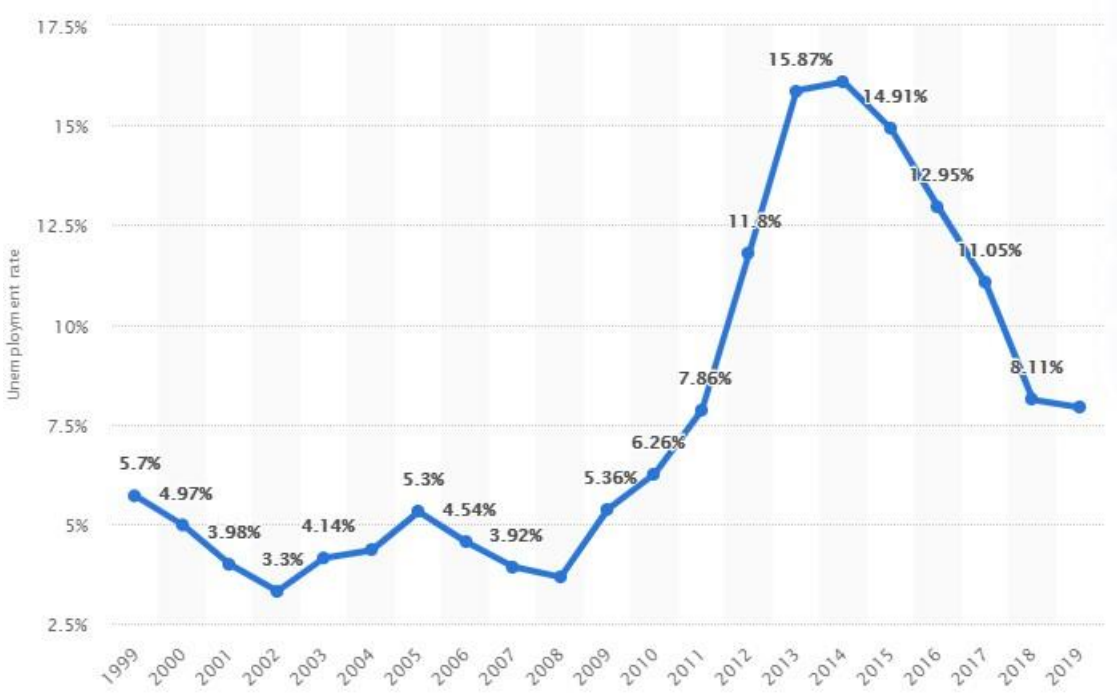


Figure 6, Cyprus employment 2010 – 2020 Source: Statista 2020



16 *Addressing Employment and Training Needs in 2019*. EPALE, 2018.

Figure 7, Cyprus unemployment rate 1999 – 2019 Source: Statista 2020

According to the results of the Human Resource Development Authority of Cyprus (HRDA) study "Employment Forecasts in the Cyprus Economy 2017-2027", the financial crisis has led to changes in the labour market. The structure of the Cypriot economy is drastically differentiated by a significant decline in employment in traditionally strong areas of economic activity but also the emergence of the prospect of new and / or existing sectors being developed. Having regard to the significant changes in employment and projected aggregate demand, both in the fields of economic activity and in occupations, the importance of timely and effective implementation of strategic employment and human resources development measures in Cyprus is confirmed. [17]

The emerging needs of the labour market shape the strategic goals of the country, which include among others:

- Implementation of an integrated tourism strategy, in the context of the studies that have been completed, with the aim of enhancing competitiveness, reducing seasonality and increasing the value added of the sector through the upgrading and enrichment of the tourism product, the creation of new types of deployments, as well as developing a strong "brand".

- Expansion of the maritime sector through the adoption of new measures for the further development of the Cyprus registry and the maritime cluster of Cyprus.

- Support for the primary sector and development of the rural economy, aquaculture, organic farming and industrial products of agricultural origin.

- Promotion of green growth and the creation of green jobs, with a particular focus on waste management, reducing greenhouse gas emissions, recycling water and adapting to climate change.

- Development and utilization of energy reserves of hydrocarbons in the Cyprus Exclusive Economic Zone and strengthening their prospects renewable sources of energy, in particular by exploiting the advantage of solar energy.

- Modernization of the professional services sector, which is an important part of Cyprus exports, with a view to its further development and expansion of new industries and markets.

- Development and implementation of the new National Industrial Policy with the aim of developing a "smart" and technologically advanced industry with enhanced participation

17 HRDA, *Forecasts of Employment Needs in the Cyprus Economy 2017 – 2027*. Nicosia: ANAD, 2017.11
Addressing Employment and Training Needs in 2019. EPALE, 2018.

in the country's GDP. Enhancing digital and industrial skills, integrating key technologies, investing in research and innovation to develop innovative high value-added products and services and promotion of export-oriented industries.

- Implementation of measures to support exports, including improving the extroversion and export capacity of businesses, and the penetration of foreign markets, the effective exploitation of markets abroad and the development of economic diplomacy[11].

Returning the economy to increasing growth has begun to create prospects for new jobs through program implementation of initial training. It also stresses the need to acquire new or upgrade existing knowledge and skills of the human resources of Cyprus through the implementation of continuing training programs.

1.1.5. ITALY

Italy's unemployment rate decreased to 6.3% in April of 2020, the lowest since November of 2007 and below market expectations of 9.5%, as the number of inactive people increased by 746 thousand to 14.578 million, its highest since November of 2011 due to the coronavirus crisis. The number of unemployed people fell by 484 thousand to 1.543 million and employment decreased by 274 thousand to 22.881 million. The youth unemployment rate, measuring job-seekers between 15 and 24 years old, decreased to 20.3 percent, the lowest since January of 2008, from 26.5 percent in March. The employment rate, one of the lowest in the Euro Area, went down to 57.9 percent from 58.6 percent. [18]

According to a forecast from March 2020, the unemployment rate in Italy could reach 11.2 percent in 2020, due to the impact of the coronavirus (COVID-19) outbreak. It is then expected to decrease to 9.6 percent in 2021. Italy's unemployment rate almost reached 9.9 percent in 2019. Unemployment in Italy started increasing after the 2008 financial crisis and peaked at 12.7 percent in 2014. As of 2020, the coronavirus (COVID-19) outbreak had a negative impact on several industrial sectors in Italy. Especially, it is estimated that the hotel and catering sector will experience the largest decrease in terms of consumption value. [19]

The professionals most requested by Italian companies are those who operate in the digital technology sector. Italian companies need graduates in electronic and information engineering, in industrial engineering. But also technicians and specialists in scientific and information technology disciplines. Profiles with strong digital skills, which, if they are well-paid in the IT sector, are sometimes paid even better in non-tech sectors that have been invested by digital transformation. In particular, the company areas with the greatest difficulty in finding them are those of information systems, design and research and development. The need for tech specialists is

18 Data from https://tradingeconomics.com/italy/unemployment-rate, last accessed on 3.5.2020
19 Data from https://www.statista.com/statistics/1109090/forecasted-unemployment-rate-in-italy/, last accessed on 3.5.2020

concerns not only companies working in the IT sector, but also companies active in other sectors, from legal to manufacturing, from banking to pharmaceuticals.

The advancement in ICT and automation technology will lower the demand for routine-based occupations such as metal, machinery and related trade workers and general and keyboard clerks. Taking into accounts the various effects, the occupations which are expected to show the highest increase in employment are administrative and commercial managers and hospitality, retail and other service managers. On the other hand, occupations in declining and/or affected by automation are expected to decrease, like metal, machinery and related trade workers.

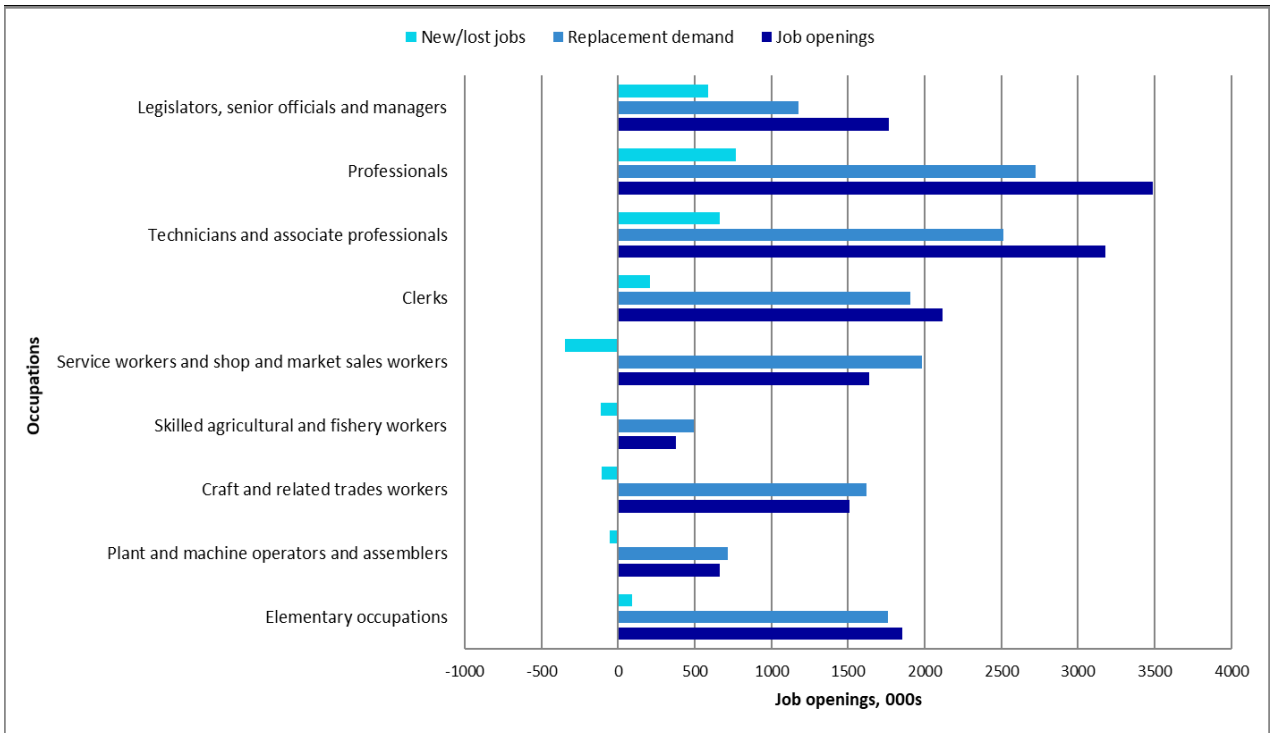


Figure 8, Job openings by broad occupational group, 2016-30, CEDEFOP, Skills forecast Italy

A study conducted by the European Economic and Social Committee looked at the impact of the digitalisation and on-demand economy on the Italian labour market, and in particular how it changed the roles of employers, employees and organisation of work. This includes enterprises active in traditional businesses and industries as well as platforms and special agents active in the on-demand economy. Based on this study, if digitalisation destroys jobs on a net basis, this would not necessarily lead to structural unemployment. Hence, the working-age population is growing much less rapidly than in the past and is even about to decline in some developed countries, such as Italy.

According to some forecasts[20], employment was expected to grow in Italy in 2016-21 while the growth rate was to remain below the EU-28 average. Employment growth was expected to peak in 2021-26, staying above the EU-28 average until 2030.

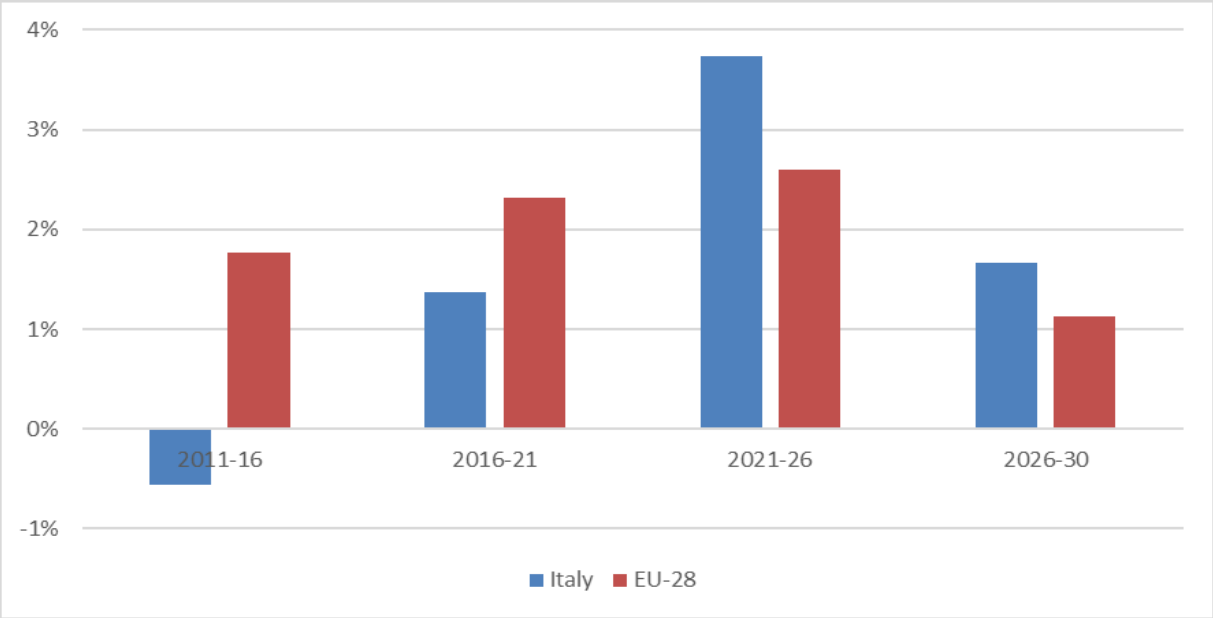


Figure 9, Expected growth of employment, Skills forecast Italy

However, this remains to be off-set against the impact of the COVID-19 crisis and its effects.

Overall, digitalization is likely to bring a lot of opportunities for workers, as flexibility can go hand in hand with more autonomy, more learning, a better work-life balance or even new employment possibilities. For example, workers may achieve a better work-life balance if they can work from home or when it suits them best. In Italy, some trade unions underline the potential benefits of digitalisation for workers in terms of flexibility, autonomy in work, the end of routine tasks and training opportunities.

1.1.6. LATVIA

At the beginning of the Q2 of 2019, Latvia had an average of 2 million (1,916.2 thousand) inhabitants, of which about half or 1 million (976.0 thousand) were economically active.

A large part of the inhabitants of the surrounding areas work in the capital city, Riga. The registered unemployment rate in April 2019 was 6.3%. In Riga region, the registered unemployment rate was the lowest in the country - 4.1%; the highest unemployment rate was registered in Latgale region - 14.9%. [21]

20 https://www.cedefop.europa.eu/files/cedefop_skills_forecast_2018_-_italy.pdf
21 https://www.nva.gov.lv/index.php?cid=6&mid=649, last accessed on 25.02.2020

In 2018, 909.4 thousand or 64.5% of the population aged 15-74 were employed in Latvia (results of the Labour Force Survey of the Central Statistical Bureau of Latvia (CSB)). Over the year, the employment rate increased by 1.6 percentage points and the number of employed persons by 14.6 thousand.

There is a demand in the labour market for workers who, in addition to the specific knowledge required for the profession, also possess some basic competences, such as knowledge of foreign languages. In the medium to long term, demand will continue to grow mainly for highly qualified professionals.

Table 3

Occupations with the most significant increase (forecasts, 2018)

The industry	Increase, %
Physics and Engineering Specialists	4.2
Builders and builders. Workers	2.6
Manufacturing and mining, logistics	2.6
Information Technology Operations and User Spec.	2.6
Programmers	2
Engineers (except Electrical Engineering)	2
Trade, marketing, public relations.	1.8
Mechanical engineers and repairers	1.8
Senior specialists in databases and networks	1.7
Doctors	1.5
Electrical equipment installers, repairers	1.5
Nurses, midwives	1.4
Health professionals	1.4
Teacher assistants, child minders	1.4

Table 4

Occupations with the highest projected reductions

The industry	Decrease
Industrial and other workers	-4.8
Shop sellers	-3.5
Home, office cleaners	-3.1
Sales agents and purchasing agents	-2.3
Other workers in simple occupations	-2.2
Senior specialists in administration, administration	-1.9

Mines, construction workers	-0.9
Transport workers and loaders	-0.9
Garbage collectors	-0.9
Material and transport activity accounting staff	-0.8
Primary and pre-school teachers	-0.5
Secondary education teachers	-0.4
Administrative and specialized secretaries	-0.4
Cashiers and related professions	-0.4
Agricultural, forestry and fishery workers	-0.3

The shortage of qualified specialists could reach over 17 thousand by 2025 in such areas as:

- energy,
- computer science,
- construction and civil engineering,
- electronics and automation.

Also, the shortage of health and social care professionals in the labour market will remain unchanged.

According to the forecasts of the Ministry of Economics, the largest surplus of labour force will be in service and trade professions, as well as in clerical professions, where the majority of employees have secondary general education, while the number of job seekers with such education will remain high.

Significant labour surpluses will remain in the ordinary professions, given the medium-term increase in labour supply with primary education, as well as the significant labour surplus with general secondary education.

Table 5

Sectoral labour needs

	Electronics and Electrical Engineering	Chemistry and Pharmacy
Occupies, %	0.6	0.6
% from total income	0.8	1.3
Unemployment in sector, %	3.7	3.8
Productivity, % *	54	32
Income, gross €	1066	1383
Jobs	5000**	5600

* Compared of average in EU

** In the medium and long term, the number of jobs in the E&E industry could increase by 1.9 thousand by 2035.

1.2. PROSPECTIVE OF EMPLOYABILITY

1.2.1. BULGARIA

Teachers and IT professionals will be among the most sought-after university graduates in the near future in Bulgaria. Over the next 3 to 5 years, Bulgarian business will need more than 20,000 IT professionals and a little more than 17,000 teachers and trainers. The data of the business research show that in 2020, the Bulgarian business will need 90 500 specialists with qualifications or higher education. There is a growing demand for personnel in the areas of AI, Machine Learning, IoT, VR&AR, Big Data, Blockchain, 3D modelling and animation, and more. Software developers, QA engineers and technical support specialists continue to be among the most sought-after personnel in the technology market in our country.

Future employment growth (in %) in Bulgaria in 2018-2030 across sectors

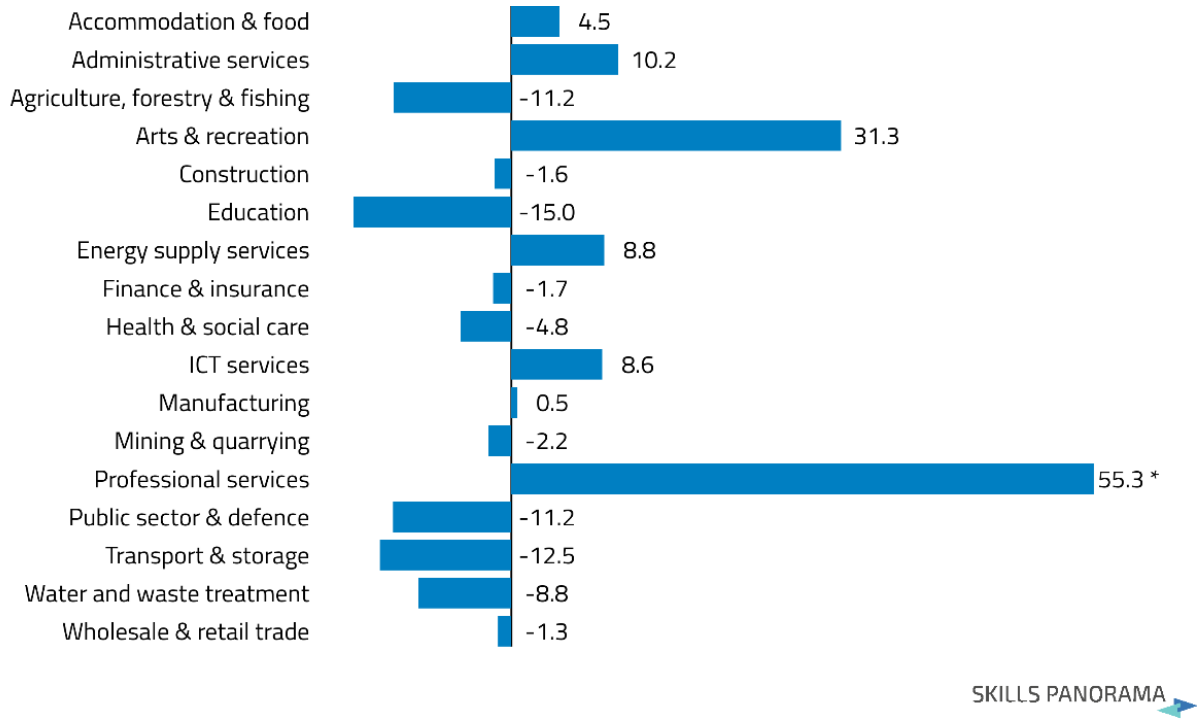


Figure 10, Bulgaria: Mismatch priority occupations, SkillsPanorama, CEDEFOP, 2018

Over 50% of the developers work in the field of mobile app development. This also requires the search for specialists with experience in development tools that allow the creation of mobile applications for various platforms. Professionals at all levels are sought, from trainees and

beginners to team leaders and project managers. According to the HR managers of some of the top companies in the country, the leading criteria in the selection of personnel are technical knowledge and skills, motivation and desire to learn.

Other demands in different industries are in machine operators, builders, welders and electrical engineers continue to be among the most sought-after professions. The emergence of the top 20 crop workers, as well as the intention of more than 30% of employers in the economy to hire labour, speaks to a growing presence of the agricultural sector in shaping the country's economy. Increased construction in the period of economic growth also determines the significant demand for construction professionals. The tailoring sector remains one of the most sustainable sectors and demand for skilled labour is always strong there. In recent years, there has been a lack of demand for engineering education in both vocational and higher education, and therefore policies are aimed at attracting more children and students to these vocational fields.

Future employment growth (% change) across occupations in Bulgaria in 2018-2030

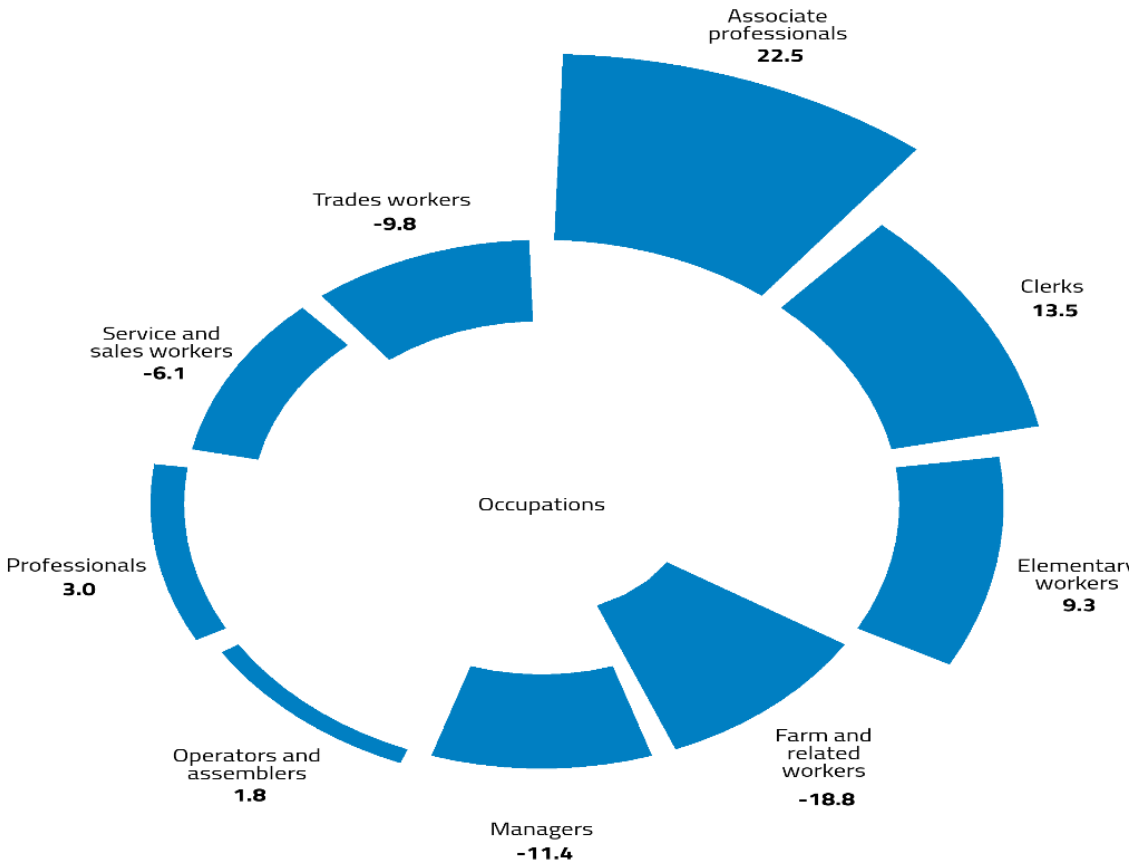


Figure 11, Bulgaria

Professions related to programming, computer systems analysis, marketing and market research are projected to occupy an increasingly important place in the business environment by 2025. To take up such a position, IT and computer skills are number one priority.

1.2.2. GREECE

Greece ranks in the bottom 20% of OECD countries in regard to both the alignment of skills with the labour market and the intensity of skills use in workplaces and the adoption of high-performance workplace practices, which are found to stimulate skills use in the workplace. [22] The country has the largest proportion of over-skilled workers; in the period 2008-2017, the percentage of over-skilled workers increased by 60.6% with more than three out of ten high-skilled employees covering jobs that required lower-level qualifications. [23] The mismatch of qualifications is due to first, the availability of jobs in sectors of the economy that are not knowledge-intensive, and second, the lack of connection between education and training systems with the needs of the labour market.

According to CEDEFOP's Skills Panorama[24], for the period up to 2030 there will be a continuing upward trend in the demand for sellers and service providers (including tourism), public and private sector professionals (doctors and health professionals, architects, chemists and physicists, education, IT and telecommunications professionals, etc.) and technical and assistant professionals. The sectors in which employment will grow during the period 2018 to 2030 are shown in Figure 12.

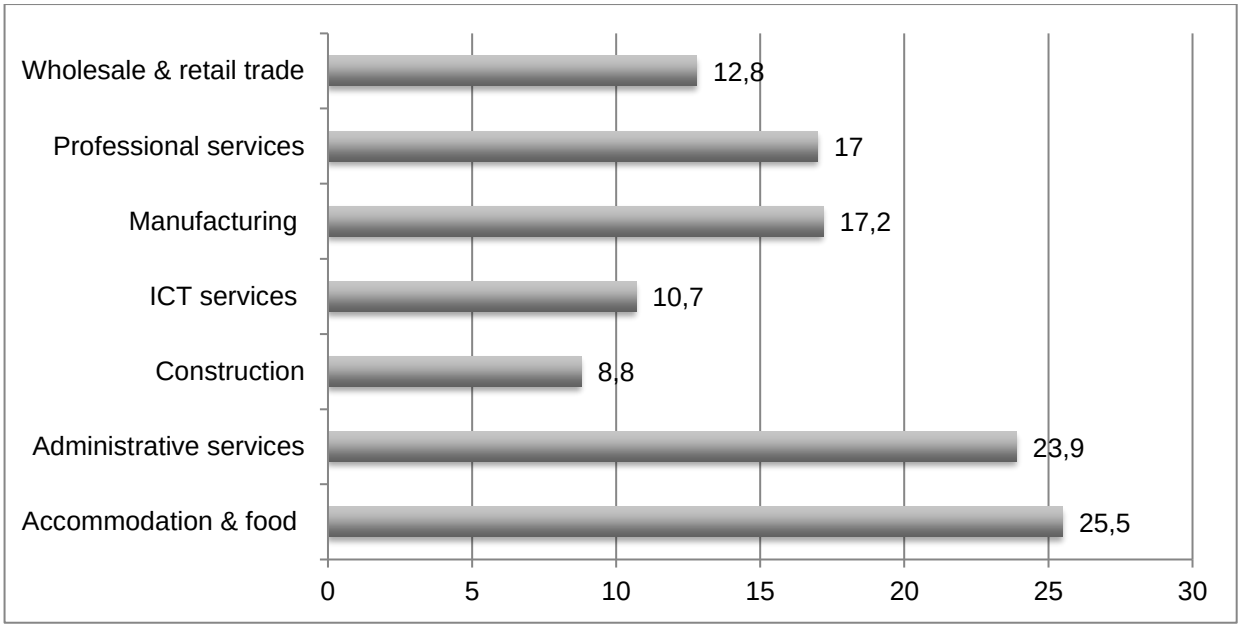


Figure 12 Future employment growth (in %) in Greece in 2018-2030 across sectors

22 OECD (2019) OECD Skills Strategy – Greece, available at: https://www.oecd.org/greece/Skills-Strategy-Greece-EN.pdf, last accessed 3.4.2020
23 Hellenic Federation of Enterprises (2019) *Skills Mismatch*, Special Report (in Greek) available at: https://www.sev.org.gr/vivliothiki-tekmiriosi/special-report-to-mellon-tis-ergasias/1-stous-3-ellines-ergazetai-se-douleia-katoteri-ton-prosonton-tou/, last accessed 3.4.2020
24 Available at https://skillspanorama.cedefop.europa.eu/en/countries/greece, last accessed 3.4.2020

Future employment growth average in Greece over the period 2018-2030 is estimated at 2.4%. The maximum growth is forecasted in the Accommodation and food sector (25.5%), closely linked to the growth in the Greek tourism industry, which is currently undergoing a major strategic improvement initiative, focusing on the expansion of the tourist period, the attraction of higher-value tourist segments, the increase of average daily spending and the opening of new tourist markets. The upgrading of the tourist product is supported by a number of initiatives by the Greek state, the Greek National Tourism Organization, the relevant business associations, and the regional authorities and municipalities, and is considered to be a strategic avenue for growth in the Greek economy.

With regard to ICT services, the Greek government supports digital job creation and boosting eSkills in order to tackle unemployment. [25] During the last few years, Greece became the centre of several important investment initiatives announced by some of the largest companies in the global ICT industry such as Nokia-Siemens, Oracle ZTE, Samsung Huawei, SAP, Unisoft and others. They are attracted to Greece partly because of the country's excellent reputation for training electronic engineers and besides the shortage of ICT professionals in the Greek labour market.

Overall, the number of ICT business opportunities is expected to increase significantly over the next years driven mostly by:

- the strong requirement to further automate and digitize the public sector, which is driven by several major public procurement projects in the ICT field,
- the quick adoption of a new technology by the Greek public, including for example new communication devices (smartphones, tablets), broadband telecommunications and smart TVs,
- the significant growth of technology clusters, incubators, accelerators and VC activity focused on new ventures in ICT, and the large number of entrepreneurs, who are actively leveraging this infrastructure,
- several innovation and research activities currently being pursued in Greek polytechnic institutions and public RTOs in such areas as cloud computing, location-based services (LBS), nanotechnology and intelligent systems.

In addition, Greece is home to a growing start-up ecosystem. Recently, foreign investment funds have invested in three or more Greek start-ups, such as Intel Capital, Index Ventures, Accel and others.

25 See the Greek National Digital Strategy (NDS) (2016-2021).

1.2.3. SWEDEN

Sweden is generally considered to be one of the most competitive economies in the world. Policymakers stress the importance of ensuring that the skills of the population are fully developed and utilised; in relation to young people, the emphasis in this regard has been upon ensuring that they continue in education and training and complete their studies. The country has been hit by recession strongly but has recovered very well. The employment rate and recent employment growth were above the EU average and the country should perform well also in future years. The strongest employment growth is expected in health & social care sector (see Figure 13 below), public administration and also in construction. The fastest growing occupations will offer variety of skills and qualifications needed: office administration professionals, care workers or drivers & plant operators. Almost half of total job openings (including replacements for vacated jobs) till 2030 will need high qualification level. Sweden is increasingly shifting towards high-skilled economy; still some opportunities for people with low qualifications will be there in forthcoming years. [26]

Future employment growth (in %) in Sweden in 2018-2030 across sectors

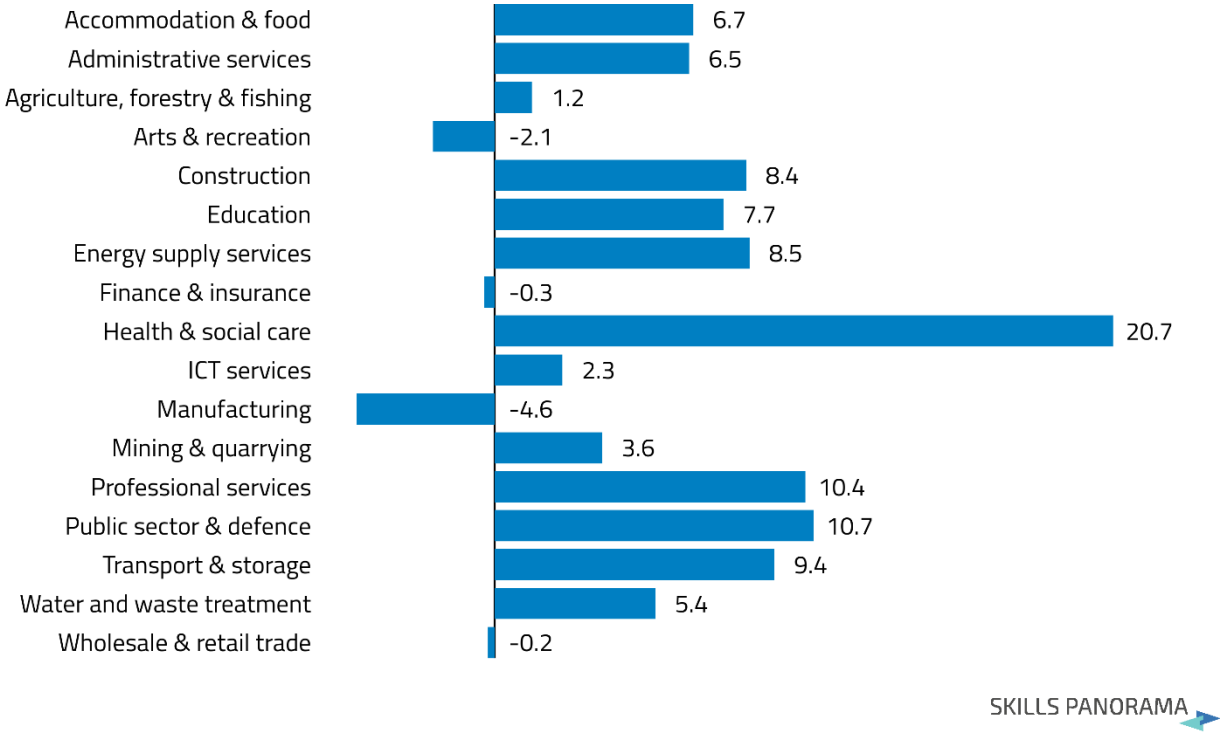


Figure 13, Future employment growth, Sweden

- The number of gainfully employed persons aged 16–74 is expected to increase by more than half a million people, amounting to roughly 5.04 million in 2035.

26 https://skillspanorama.cedefop.europa.eu/en/countries/sweden, last accessed on 3.5.2020

- Employment growth is anticipated in high-skilled occupations such as the technical area and IT.
- While skills shortages are increasing in some areas, Sweden is experiencing under-utilisation of skills at the same time.

According to the Swedish Public Employment Service, in 2024, the greatest competition will be for the following jobs:

At tertiary level:

- Bank clerks
- Chief Secretary and CEO Assistants
- Real estate brokers
- Financial analyst and investment advisory board
- Photographers
- Graphic designer
- Informants, communicators and PR specialists
- Musicians, singers and composers

At other levels of education:

- Gas station staff
- Retail sellers, groceries and specialist retailers
- Finance Assistants
- Hand packers
- Coffee- and pastry assistants
- Cashiers
- Prepress technicians, printers and bookbinders
- Advertising distributors and newspaper distributors
- Travel sellers and traffic assistants
- Caretakers

Note that quite a few of the occupations with great competition listed above are connected to automation and IIoT. According to the research on skills mismatch and the future skills requirements across the EU states and across all sectors, CEDEFOP has made the following forecast with regard to Future employment growth (% change) across occupations in Sweden in 2018-2030 (Figure 14).

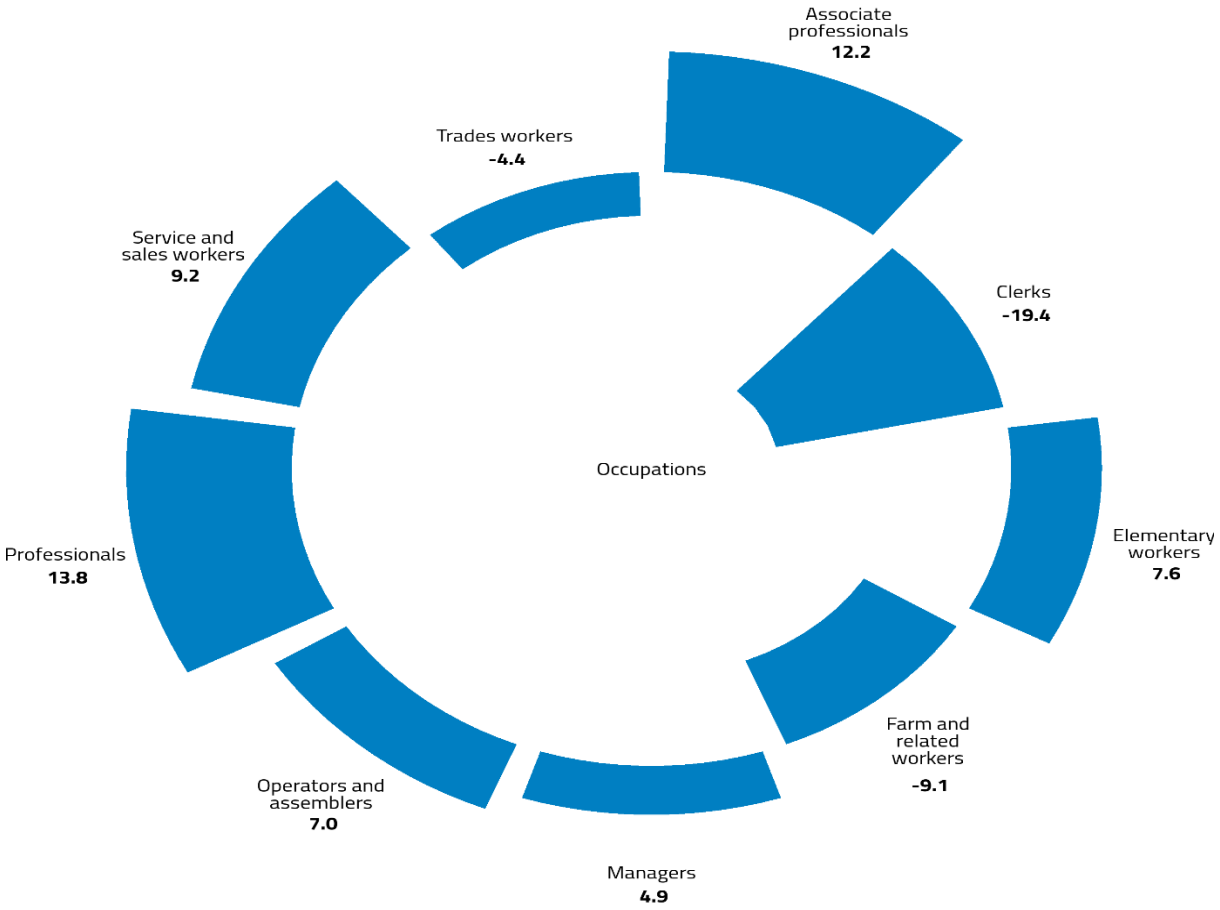


Figure 14 Future employment growth, Sweden

1.2.4. CYPRUS

According to the Human Resources Development Authority (HRDA), the vast majority of employed persons in Cyprus will continue to be in the tertiary sector showing a significant increase. As a result, more than 8 out of 10 persons will be employed in the tertiary sector, reflecting the dependence of the Cyprus economy on Services.

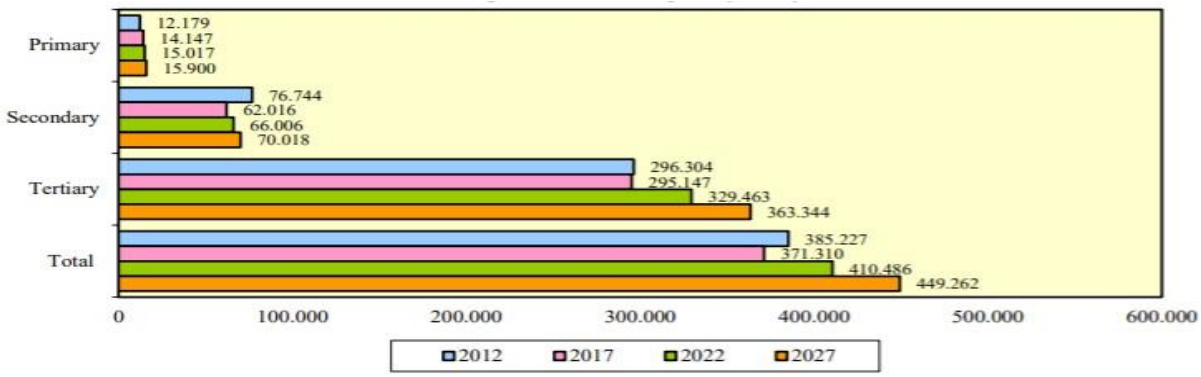


Figure 15, Employment forecasts in broad economic sectors for the period 2017 – 2027 Source: anad.org.cy

According to the HRDA, among the economic sectors with the highest employment demand, 10 sectors belong to the tertiary sector, 2 to the secondary sector and 1 to the primary sector, and they will include the following:

- Retail trade (1.797 persons or 4,1% per year)
- Food and beverage service activities (1.588 persons or 6,5% per year)
- Education (1.224 persons or 3,9% per year)
- Health and social work activities (1.131 persons or 4,9% per year)
- Construction (1.084 persons or 3,3% per year)
- Legal and accounting activities (934 persons or 5,2% per year)
- Accommodation (882 persons or 5,6% per year)
- Wholesale trade (858 persons or 4,1% per year)
- Public administration and defence (820 persons or 2,7% per year)
- Arts, entertainment and recreation (477 persons or 6,1% per year)
- Other service activities[27] (453 persons or 3,6% per year)
- Agriculture, forestry and fishing (435 persons or 3,1% per year)
- Manufacture of food, beverages and tobacco products (334 persons or 3,3% per year) [28]

An increase in employment is expected for all three broad occupational categories. Almost half of employed persons will continue to be in middle level occupations (occupations that require secondary level education) while 1 in 3 employed persons will be in high level occupations (occupations that require tertiary level education). [29]

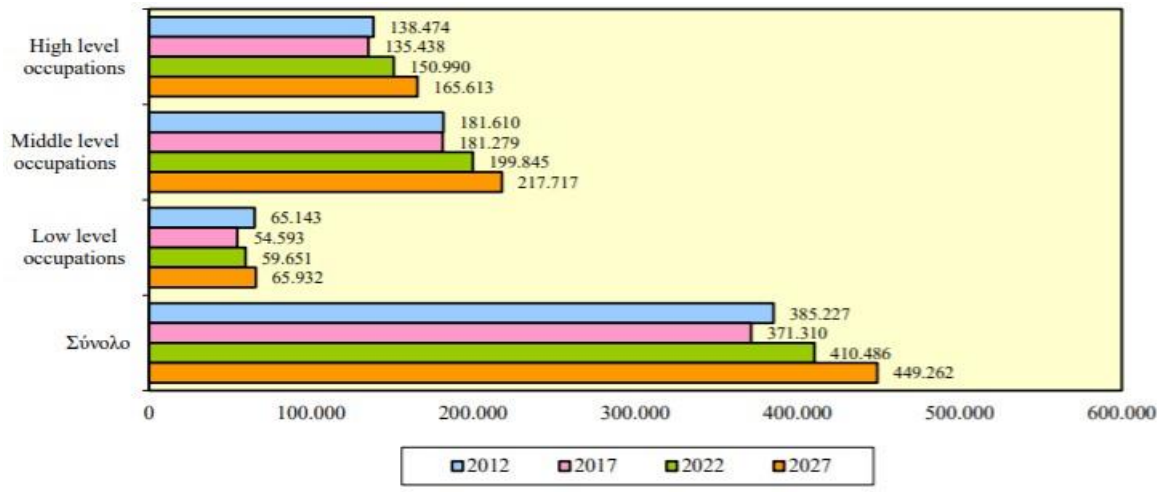


Figure 16, Employment forecasts in broad occupational categories for the period 2017 – 2027

27 Activities of business, employers and professional membership organizations, Activities of trade unions, Repair of computers and communication equipment, Repair of personal and household goods, Other personal service activities.

28 HRDA, *Forecasts of Employment Needs in the Cyprus Economy 2017 – 2027*. Nicosia: ANAD, 2017.

29 HRDA, Forecasts of Employment Needs in the Cyprus Economy 2017 – 2027. Nicosia: ANAD, 2017.

According to the HRDA, among the high-level occupations with the highest employment demand, 14 occupations belong to Professionals, 6 to Technicians and associate professionals and 3 to Managers; among the middle level occupations with the highest employment demand, 11 occupations belong to Service and sale workers, 5 to Craft workers, 3 to Clerks, 2 to Plant and machine operators and assemblers and 1 to Skilled agricultural, forestry and fishing workers.

CEDEFOP estimated, in 2018, that for the period of 2018-2030, the following employment growth across sectors is to be expected[30]:

Figure 17, Forecast of employment needs, Cyprus

In sum, the new occupations and the new forms of work will have a big impact on the labour market. Teleworking and flexible working hours will be possible, artificial intelligence and new professions will be constantly evolving, the linking of education and training programs with the labour market will be strengthened, and finally, the vulnerable working groups will be able to ensure their rights.

30 https://skillspanorama.cedefop.europa.eu/en/countries/cyprus, last accessed on 3.5.2020

1.2.5. ITALY

The Italian Government is committed to ensuring that the benefits of the present technological transition are spread rapidly and fairly. Interventions such as the Industry 4.0 plan aims to encourage the start-up of new innovative businesses and to foster the technological advancement of the Italian production system. The ultimate objective of this intervention is to improve the capacity of Italian enterprises to generate new, decent jobs that will increase work opportunities for young people and women and contribute to reducing existing territorial disparities. In this regard, the main professionals sought by Italian companies are: graduates in electronic and information engineering, in industrial engineering, technicians and specialists in scientific and information technology disciplines.

Based on the discussions and the work carried out by the working table "The Changing World of Work" set up by the Italian Ministry of Labour and Social Policy, the prospective of employability in today's world can be affected by the following aspects:

- Technological unemployment. Risk of jobs, tasks and duties becoming obsolete and risk of a decrease in the demand for work due to the automation and digitalization of production processes.

- Enhance and up-grade the skills of workers and enterprises. The development and the updating of skills of workers and businesses also requires investment in research training and in the creation of meeting infrastructures to facilitate the technological transfer between companies and the research world.

- Quality of Employment and work conditions. Digitalisation and automation impact on the quality and conditions of work, modifying the structure and the composition of the workforce by increasing the demand for highly specialized jobs, production processes and task execution methods (timing, frequency, location, ergonomics, monitoring, health and safety).

- Youth employment and the school-work transition. Given the expected growth in demand for new skills and for flexible, dynamic professionals, youth employment should be driven by new technologies.

- Integrating supply and demand-side and industrial policies. In order to reach the full economic and employment potential of digitalization and automation, it is necessary to effectively integrate labour supply policies, such as skills alignment and enhancement, enhancement of tools to foster matching between labour supply and demand; labour demand policies (reductions and tax and social security incentives); public spending policies meaning public investments oriented towards technology-intensive sectors and products; industrial policies that can encourage companies to do research and make innovative

investments and to create infrastructures to stimulate the spread of new technologies.

According to CEDEFOP [31], Italy is among those Member States in which the manufacturing sector (associated with the production of niche and luxury products) still makes up a considerable share of its economy, particularly in the north and centre of the country. The economy is characterised by a marked north-south divide, with GDP per head being much higher in the northern regions.

Italy is recovering slowly from economic recession. Unemployment rate is decreasing, but manufacturing and construction are still expected to lose jobs in the period of 2016-2030. The employment growth will be driven by administrative services, health and social care and professional services, with office associate professionals, cleaners & helpers and teaching professionals being the fastest growing occupations. Only around third half of total job openings (including replacements for vacated jobs) till 2030 will require high-level qualifications; job opportunities for people with medium- and low qualifications will still be ample (see Figure 18 below).

Future employment growth (in %) in Italy in 2018-2030 across sectors

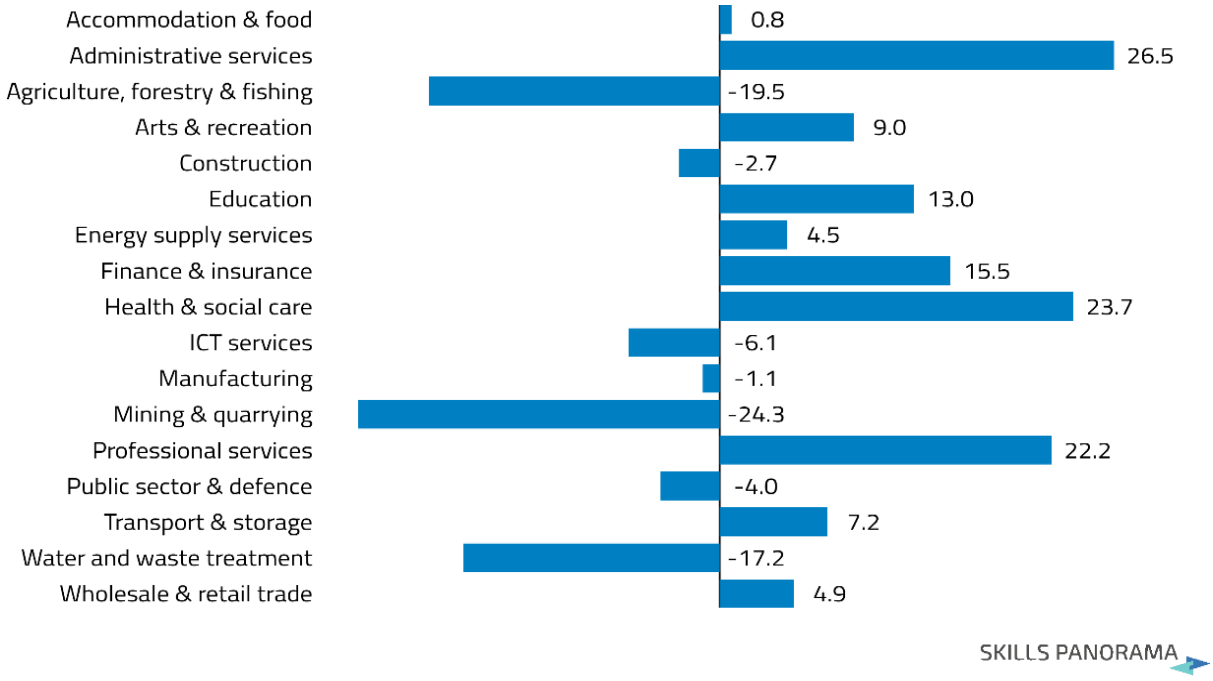


Figure 18, Source: https://skillspanorama.cedefop.europa.eu/en/countries/italy#

31 https://skillspanorama.cedefop.europa.eu/en/countries/italy

1.2.6. LATVIA

In the medium to long-term target scenario, the manufacturing industry in Latvia maintains a faster growth rate than the national average. This growth will be less about increasing material-intensive production volumes and more about using the latest technological processes, digitalisation (Industry 4.0 concept), process optimization, etc. [32]

Of the key sectors of the economy, one of the fastest growth scenarios for the medium and long term in the target scenario is for information and communication services, due to the increasing demand for digitalization of production and service processes as well as global IT industry developments.

The construction industry is expected to grow rapidly in the coming years, driven by both private sector investment and EU fund investment. In the target scenario, the sector is expected to continue to grow steadily beyond 2020, driven by both major investment projects (such as Rail Baltic) and the need to gradually rebuild existing housing stock.

The growth of the transport to storage sector will be greatly facilitated by the development of the air transport and road transport sectors. In the transit sector, in turn, the momentum will be slower, driven by the need to look for new forms of cargo and supply routes to replace the already declining volumes of Russian oil and coal shipments.

The number of workers in the agricultural sector will continue to decline. Currently, 6.9% of all workers aged 15-74 are employed in the sector. In the long term, the number of people employed in the sector will shrink to around 3.3-3.5%, which corresponds to the sector's value added in the economy.[33]

The development of the domestic demand-oriented sectors - trade and other commercial services - will be closely linked to the dynamics of private consumption and the demand generated by other sectors of the economy. Public service sectors (public administration and defence, education, health and social care) are closely linked to demographic trends. In the long term, public services sectors are expected to grow faster in health and social care, which is linked to an aging population.

The target scenario for 2035 does not imply a major change in the structure of economic sectors compared to the current situation. The share of commercial services sectors could increase by 1 percentage point by 2035. The share of IT, construction and industry sectors in the economy is

32 Information report of the Ministry of Economics of the Republic of Latvia on medium and long-term labor market forecasts, 2018
33 Information report of the Ministry of Economics of the Republic of Latvia on medium and long-term labor market forecasts, 2018

also expected to grow. In contrast, the share of agriculture, transport, financial services and public utilities sectors may decline slightly.

Future employment growth (in %) in Latvia in 2018-2030 across sectors

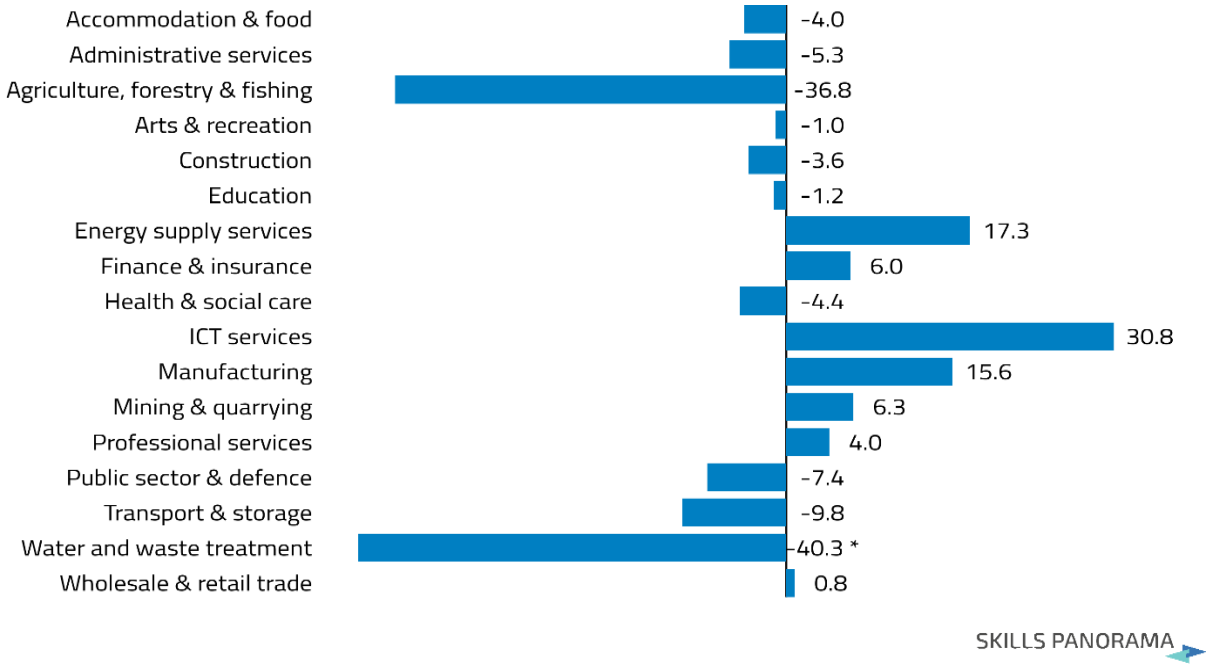


Figure 19, Source: CEDEFOP Skills forecast, 2018.

Technological progress will also have a major impact on employment. Demand for digital skills will grow - 85% of all jobs in the EU are expected to have at least basic digital skills by 2025. However, Latvia is one of the countries with the highest proportion of employees (more than 1/5) who have indicated that their work does not require ICT skills. Although employment trends will be heavily influenced by automation and robotization, recent studies show that the number of jobs at risk of automation is much smaller than originally thought and only less than 5% of existing occupations are fully automated, but 60% of occupations are at least 1 / 3 of their responsibilities are subject to automation. However, it should be noted that, unlike in the past, typical innovation cycles are faster and automation / robotization is entering many highly skilled professions.[34]

The increase in labour demand by 2025 will come from four sectors - commercial services, construction, trade and manufacturing. In the long run, however, growth will be in all sectors mentioned above except trade.

In the medium to long term, demand will continue to grow mainly for highly qualified professionals. This will be driven by an increase in demand for labour in manufacturing and

34 Information report of the Ministry of Economics of the Republic of Latvia on medium and long-term labor market forecasts, 2018

services, particularly commercial services. In the long term, the fastest growth in demand is expected in services and manufacturing, as well as trade and transport.

Future employment growth (% change) across occupations in Latvia in 2018-2030

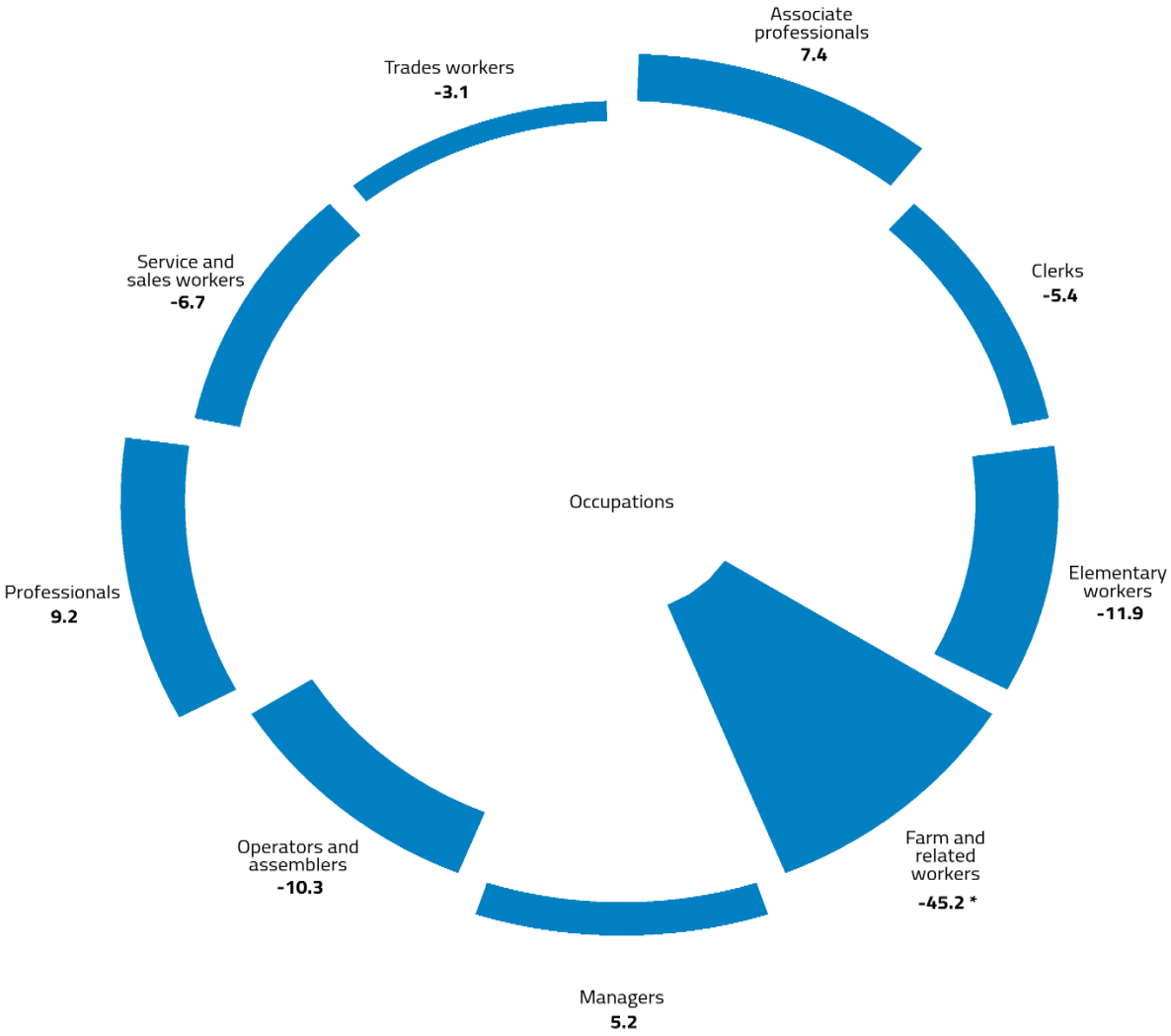


Figure 20

The fastest decline in labour demand will be in low-skilled occupations; however, all sectors will be affected. Given the demographic trends, the supply of adequately qualified labour could be significantly reduced in the future, and the role of vocational secondary education will continue to grow.

4. Current state of implementation of Industrial internet of things in Six EU countries

2.1. Concept of Industrial Internet of Things

The industrial internet of things (IIoT) refers to the extension and use of the internet of things (IoT) in industrial sectors and applications. With a strong focus on machine-to-machine (M2M) communication, big data, and machine learning, the IIoT enables industries and enterprises to have better efficiency and reliability in their operations. The IIoT encompasses industrial applications, including robotics, medical devices, and software-defined production processes. [35]

Industry 4.0 has emerged in the direction of the previous three industrial revolutions (Figure 21)[36].

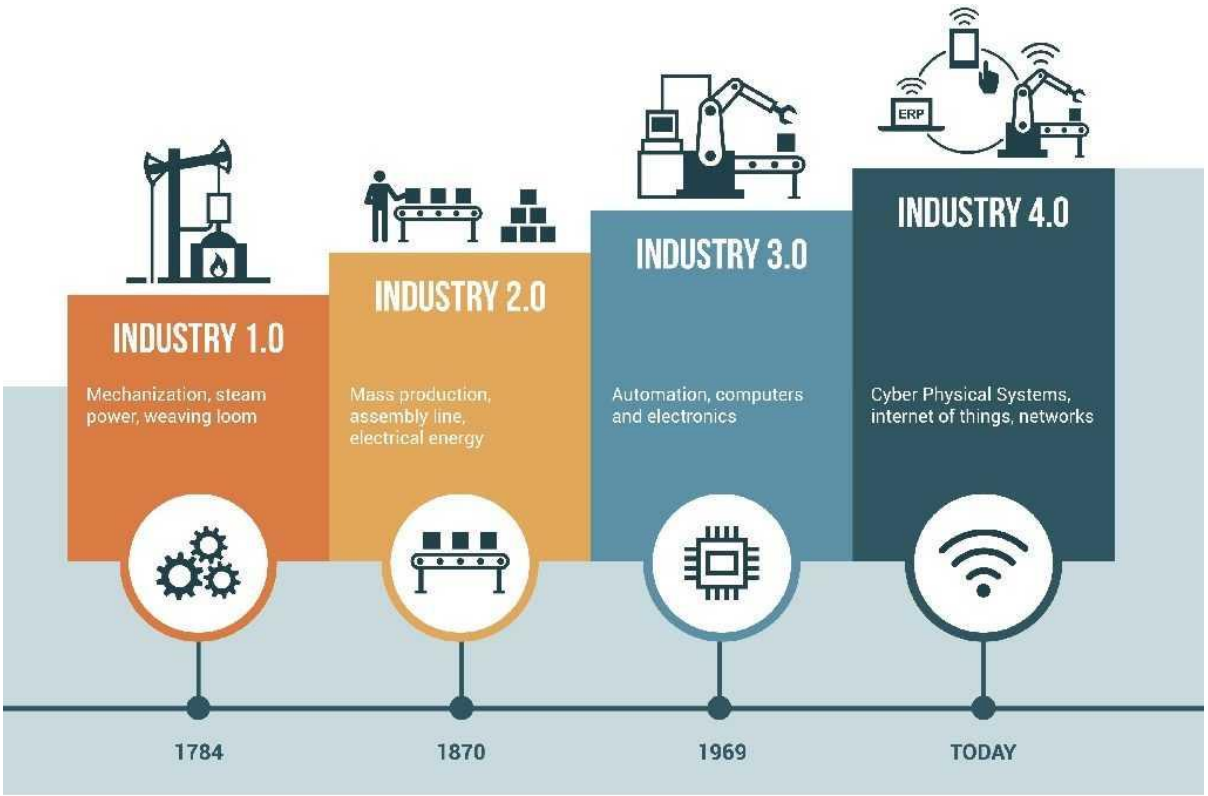


Figure 21 Development of Industrial Internet of Things

Industry 4.0 represents the future of smart industrial technology. Industries 4.0 is a global network of people, equipment and products, and an autonomous, decentralized production unit management and organization. [37]

35 https://www.trendmicro.com/vinfo/us/security/definition/industrial-internet-of-things-iiot
36 https://www.sis-egiz.eu/novice/2017092908110480/industrija_40__smo_pripravljeni_na_druzbo_50/.
37 https://www.masoc.lv/jaunumi/masoc-zinas/ceturta-industriala-revolucija-industrija-40.

The added value of Industry 4.0 is the networking of manufacturing companies, suppliers and potential customers to help maximize productivity.

The first industrial revolution took place between 1760 and 1840, when manual work was replaced by mechanical equipment. The emergence of conveyors and mass production in the late 19th and early 20th centuries mark the Second Industrial Revolution. The 1970s experienced the Third Industrial Revolution, sometimes called the Digital Revolution. During this period, digital technologies, central and personal computers were introduced in industry and other areas of society. All three industrial revolutions have brought radical changes in the conditions of production that have affected the whole society.

The fourth industrial revolution is at the heart of the third digital revolution. In digital, robotic and automated factories, a lot of work is done by machines and robots, and people only oversee them - a reality for many companies around the world.

The Fourth Industrial Revolution, also known as the Internet of Things, means the complete computerization of the industry, the basic principle of which is to connect mechanisms and systems to develop smart networks in a common chain where self-service, production process management, helps to analyse and optimize production. [38]

Industry 4.0 can be also perceived as a natural transformation of the industrial production systems triggered by the digitalization trend. This hypothesis is supported by comparison of 'conventional' topics in industrial production systems and Industry 4.0 topics depicted in Figure 22. [39]

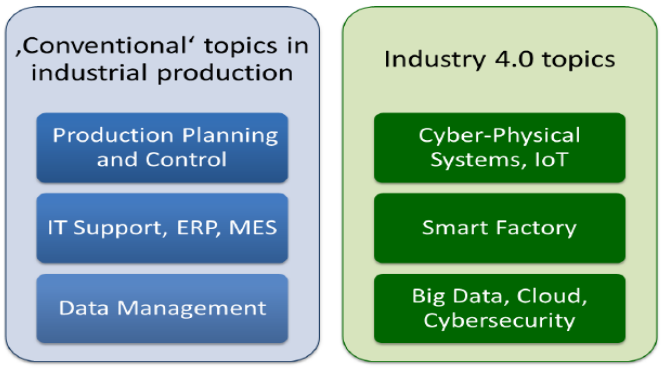


Figure 22 Comparison of topics in conventional industrial production and the Industry 4.0 topics

It is obvious that the main issues/topics did not really change, just the technology and approaches for tackling the connected issues are new.

38 Ibid.
39 Andreja Rojko, "Industry 4.0 Concept: Background and Overview", 2017 Available at: https://online-journals.org/index.php/i-jim/article/view/7072 iJIM – Vol. 11, No. 5, 2017

Key elements of the Fourth Industrial Revolution

The Fourth Industrial Revolution differs from previous revolutions in several important aspects and can be characterized by the following main features (Figure 23)[40]:

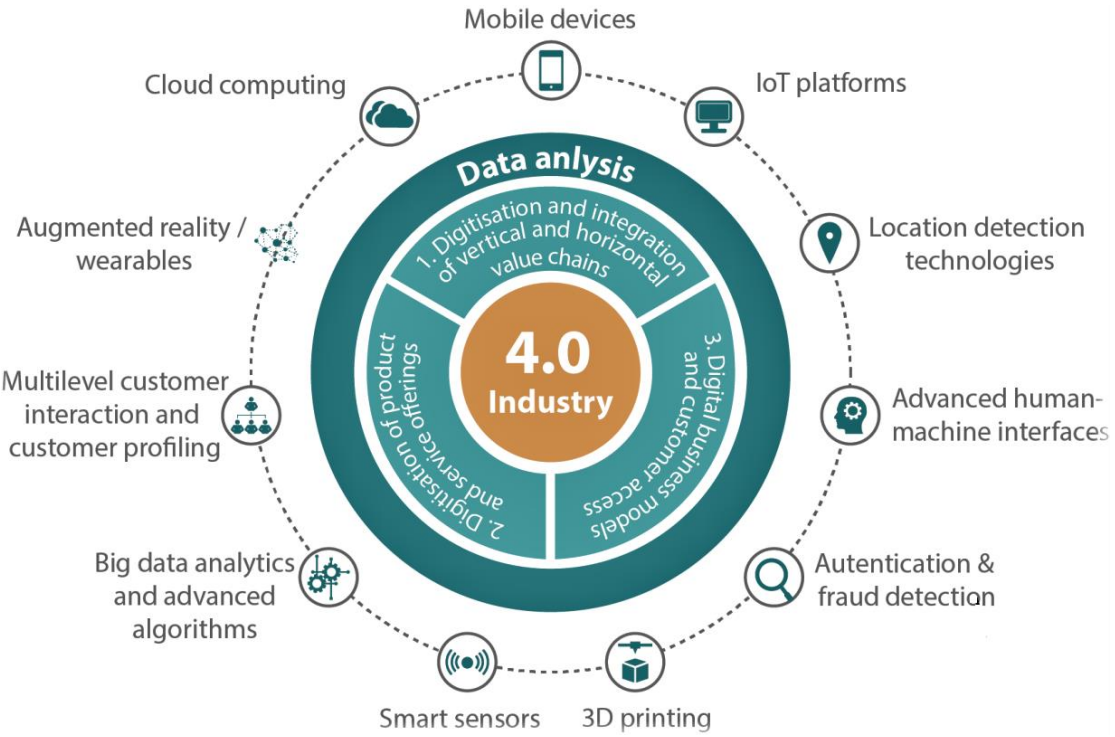


Figure 23 Industry 4.0 technologies

Social media. Social media differs from traditional media such as television or radio in their communication style. Communication through social media is interactive and digital. Industry in developed countries uses these media for communication between companies. Social media builds the image of companies and provides access to information worldwide, enabling companies to provide relevant information.

Interdisciplinarity. Interdisciplinarity should be understood as a combination of scientific disciplines that are independent of each other, their methods, their assumptions or their ways of thinking. The fourth industrial revolution is based on synergies between several scientific disciplines, for example, mechatronics has been created by combining mechanics and electronics with the addition of knowledge in management and information technology.

Virtualization. In a virtual environment, its users can better manage resources without real-world devices and better understand how they work and how they are managed. These principles can

40 https://www.masoc.lv/jaunumi/masoc-zinas/ceturta-industriala-revolucija-industrija-40

also be applied to production. Virtualization can also be used as a simulation of a company's technological processes.

Cloud technologies are a combination of Internet services that connect information resources and software to different servers, enabling developers to access data from multiple locations.

Smart objects. Intelligent or intelligent objects include, for example, materials, individual parts equipped with digital storage media. This is necessary to identify and describe these objects. This process, for example, uses barcodes or radio frequency identification chips embedded in scanners and computers.

Internet of Things. The Internet has evolved from the media to a place for the exchange of information through interactive connections between people and devices. The Internet of Things is an appropriate solution for connecting any type of object into a single digital network that communicates with the environment and equipment.

Big data. Collecting, storing, and analysing big data is essential for the future development of Internet technologies. Big data represents the global trend for big data to grow rapidly. The value of using big data in the production process is based on the fact that this data can be used in automation, visualization and analysis of industrial processes.

The goal of analysis and optimization is to get the most value out of big and complex data. As a result, quantitative data processing and analysis are becoming increasingly important in manufacturing.

Cyber-physical systems are systems in which the computer communicates with and controls physical (real) devices. The Smart Controller manages production and controls production processes independently.

Smart or smart factories represent a new understanding of the use of the Internet in manufacturing, where people, equipment and their components communicate with one another through the use of the Internet in manufacturing. Smart manufacturing has a positive impact on the environment, reduces pollution and supply costs, produces and uses energy in a decentralized manner, and increases production productivity. [41]

In the following chapter, the current state of affairs with regard to implementation of the Industrial Internet of Things is looked at. Analysis is based on the experience of six EU partner countries to this project—Bulgaria, Greece, Sweden, Cyprus, Italy, and Latvia, as reflected in various local surveys and research, as well as in the Digital Economy and Society Index.

41 Ibid.

2.2. Bulgaria

The overall Value at Stake in the IoT public sector in Bulgaria is estimated at $2.8B. It will result from IoT's ability to help public-sector organizations manage assets, optimize performance, and create new business models. 70% of that value will come from agency-specific implementations, while 30% will derive from cross-agency use cases. The five primary drivers of IoT Value at Stake for the public sector are employee productivity, connected defence, cost reduction, citizen experience, and increased revenue.

More than two-thirds of IoT's Value at Stake for the public sector (69%) will be powered by citizen-centric connections (person-to-person, machine-to-person or person-to-machine). Cities will generate almost two-thirds (63%) of IoT's overall public-sector value at stake.

The capital of Bulgaria, Sofia, is home and workplace for 16% of the population of the country and contributes around 36% of GDP. Cisco Consulting Services estimates the IoT opportunity for Sofia at $0.81B, where 90% of the value at stake will be generated from the following 10 use cases:

1. Mobile Collaboration
2. Telework
3. Travel
4. Bring your own device
5. Connected Learning
6. Smart buildings
7. Cyber Security
8. Water management
9. Smart Street Lighting
10. Fleet management

IoT offers governments the opportunity to make significant advances in citizen services while also being more efficient. For example, Sofia can leverage "big data" analytics and crowdsourcing to expand the power of machine-to-machine communications for citizen delivery.

The overall Value at Stake in the private sector in Bulgaria is estimated at $7.6B. The major opportunities for the private sector are in asset utilization, employee productivity, and supply chain, improving customer experience, and reduced time to capabilities through innovation. For Bulgaria, the value falls into two main categories:

Cross – Industry Use Cases:

- Future of Work (Improved collaboration, mobility etc.)
- Time-to-Market
- Supply Chain Efficiency

- Travel Avoidance

Vertical Industry-Specific Use Cases:

- Smart Grid
- Connected Marketing/ Advertisement
- Smart Factories
- Physical/ Logical Security

Large organizations, government departments and the larger cities in Bulgaria can benefit directly from new technologies that transform supply-chain management and logistics in the private sector. Similarly, they can build on the potential of mobile technology to develop "smart working" practices for their employees, resulting in significant cost savings and increased productivity.

Currently, Bulgaria ranks 28th out of the 28 EU Member States in the European Commission Digital Economy and Society Index (DESI) 2019. [42] Bulgaria performs relatively well in connectivity, especially as regards the wide availability of ultrafast and mobile broadband networks. It has also made significant progress with the e-government dimension, with growing number of users and a high score for the provision of digital public services to businesses. However, Bulgaria scores well below the average in Human capital, its overall level of digital skills being among the EU's lowest. People with at least basic digital skills account for 29 % of the total Bulgarian population, against an EU average of 57 %. Only 11 % of people have skills that are above basic, which equals almost one third of the EU average. Bulgaria also performs well below the average in integrating digital technology. Companies are not yet taking full advantage of the possibilities offered by online commerce: 6 % of SMEs sell online (against the 17 % of the EU average), 3 % of total SMEs are selling cross-border and an only 2 % of their turnover comes from the online segment.

As regards integration of digital technology, Bulgaria ranks in DESI 28th among EU countries, well below the EU average. Bulgarian companies struggle to take advantage of the opportunities offered by online commerce: 6 % of SMEs sell online (against an EU average of 17 %), 3 % of all SMEs sell across borders, and only 2 % of their turnover comes from the online segment. Although Bulgarians use social media intensively for personal use, only 9 % of companies use it to promote their business, against an EU average of 21 %. Finally, the number of companies with a high-intensity index account only for 7.81 % of all companies. On a more positive note, 23 % of businesses share information online, against an EU average of 34 %.

Bulgaria has drafted a "Concept note for the Digital Transformation of Bulgarian Industry (Industry 4.0)", which should form the basis for developing a Strategy 4.0. There is also a National Programme linked to the programming of the measures supported by the EU structural fund "Digital Bulgaria 2025" 10, which outlines some measures to encourage the digitisation of

42 European Commission (2019) *Digital Economy and Society Index*, at https://ec.europa.eu/digital-single-market/en/scoreboard/bulgaria

businesses. In this context, EU funds are being used to finance four centres of excellence and nine centres of competences, specialising in disciplines including mechatronics, clean technology and IT. [43]

2.3. Greece

According to the latest official data from the Hellenic Telecommunications and Post Commission (EETT) [44] in the first half of 2018 there were more than 350 thousand Machine to Machine (M2M) connections in Greece, twice as many as in 2015, while according to GSM Association (Global System for Mobile Communications)[45] IoT connections in Greece will exceed 11 million by 2025. Most IoT services apply to shipping, energy (i.e. remote monitoring of smart grids and power plants) and agriculture (e.g. recognition and monitoring of agricultural land).

In 2018, following a public consultation, the EETT undertook regulatory actions regarding the use of the radio frequency spectrum for Internet of Things (IoT) applications. [46] The same year the EETT also reviewed regulatory arrangements for Intelligent Transport Systems. [47] In 2019, the relevant regulatory framework was updated, defining Internet of Things as "a wireless network for connecting devices integrated into everyday objects via the Internet, which makes it possible to exchange data on these objects". [48]

In August 2019, Greek operator Cosmote announced on its website that its NB-IoT network has reached 'nationwide' coverage, with 96.9% of the population within the footprint. It simultaneously announced the launch of the 'NB-IoT Data Sharing 500KB business tariff plan', specifically designed 'for organisations and businesses that use or offer NB-IoT solutions and need reliable communication even in the most difficult spots, such as buildings and basements, and low power consumption by the IoT devices without requiring frequent charging'. Cosmote has already implemented Smart Cities pilot projects using the NB-IoT network, such as smart lighting, smart parking and air pollution monitoring in the city of Patras, as well as the Smart University Campus in Xanthi, with air quality and heating oil tank level monitoring applications, as well as water quality analysis.

A few weeks earlier, in July 2019, Vodafone Greece has launched a 'Smart City' range of digital services aimed at supporting municipalities in their digital transformation process. Vodafone now

43 European Commission (2019) *Digital Economy and Society Index*, at https://ec.europa.eu/digital-single-market/en/scoreboard/bulgaria

44 The Hellenic Telecommunications and Post Commission (EETT), is an independent administrative authority. It acts as the national regulator that monitors, regulates and supervises the electronic communications market and postal services.

45 On 18 and 19 March 2019 GSMA offered a two-day training addressed to policy makers and regulators of Balkan countries on "Internet of Things" at the premises of the Hellenic Telecommunications and Post Commission (EETT).

46 Hellenic Telecommunications and Post Commission Resolution no. 882/1/4-2-2019 (in Greek).

47 A public consultation was conducted on proposed modifications to the regulatory framework for radio applications on the use of the 5855-5925MHz band for Intelligent Transport Systems (ITS). See the relevant Hellenic Telecommunications and Post Commission Resolution no. 863/2/3-9-2018 (in Greek).

48 Decision 884/1/2019 – Official Journal no 1278/B/15-4-2019: "Amendment of 721/2 / 12-6-2014 "Regulation of Terms of Use of Individual Radio Frequencies or Radio Frequency Zones" (Official Journal no 1713 /B'/26-6-2014)" (in Greek).

offers the Vodafone Giga Internet of Things solutions for Greek companies as well as services for the Industry that comprise of the Giga Smart Cities, Transport and Logistics, Industries and Construction, Health, Insurance, Data Protection, Food and beverages.

Among other companies that are involved in providing IoT service the following can be mentioned. Yodiwo, one of the most innovative IoT companies in Greece, and the winner of several international prizes. Its platform uses disruptive technology for connecting distributed systems through artificial intelligence services, creating applications in 10% of the time compared to other methodologies. Especially in verticals such as smart infrastructure and supply chain management for retail and wholesale, services based on Yodiwo's platform have a profound impact on process reliability and resource saving which in some cases exceeds 70%.

LAROS is an innovative system that enables remote monitoring and analysis of vessels operational parameters. It is a versatile tool that provides diagnosis, prognosis, and early warning by collecting and transmitting data to the operations' centre anywhere in the world in real time. In this manner, the vessel's yields are increased, while the safety and efficiency of operation are significantly improved. Many international companies from the shipping world have adopted LAROS seeking increased levels of operation, environmental protection and dynamic-preventive maintenance and coordination between crew and administration.

Intelligent vessel: With emphasis on low-cost and high-value solutions, Setel Hellas has developed an integrated bundle of equipment and software which is installed on more than 200 deep sea commercial vessels.

Still, some doubts remain about the country's preparedness to implement IIoT, as Greece ranked last among EU countries in 2018 concerning connectivity. [49] Speeding up 5G development will not only improve Greece's digital potential but, according to a 2017 study by Arthur D. Little in collaboration with Ericsson, it could add $ 4.2 billion USD to the country's GDP by 2026, if it is used to digitize ten major sectors of the economy. [50] Special attention should be paid, however, to the digitization of small and medium-sized enterprises, as they constitute the vast majority of businesses yet less than 5% of the 680,000 SMEs operate digitally.

2.4. Sweden

According to the Digital Economy and Society Index (DESI) 2018, Sweden now ranks 2nd out of the 28 EU Member States in terms of digital competitiveness. Overall progress is in line with the EU average as well as with the countries in the high-performance cluster (Denmark, Sweden, Finland, the Netherlands, Luxembourg, Ireland, the UK, Belgium and Estonia).

49 European Commission (2019) *Digital Economy and Society Index*, op. cit.
50 Ericsson & Arthur D. Little (2017) *Industry digitalization revenue model*, Ericsson AB.

Sweden is well connected and ranks 4th in the EU in this regard. However, reaching the remaining remote regions is a challenge. 95% of Swedes are online and make good use of a variety of services. In human capital, Sweden ranks third in the EU and shows progress in all DESI dimensions. Despite having the second highest number of ICT specialists in the workforce, the demand exceeds supply and the relatively low numbers of STEM graduates are not expected to increase in the coming years. Swedish businesses actively use digital technologies to improve efficiency, productivity and sales and the country continues to rank 4th. In digital public services Sweden now ranks 5th, but open data is still an area where Sweden's performance is relatively weak.

In May 2017, the Swedish government adopted a digitisation strategy that focuses on five areas: digital skills, digital security, digital innovation, digital leadership and digital infrastructure. [51] Sweden aims to become the world leader in harnessing the opportunities of digital transformation. To support the implementation of the strategy, a Digitalisation Council has been set up. It consists of 10 advisors, including the Digital Champion, led by the Minister of Digitalisation.

95% of 16-74 year olds use the internet regularly. According to *The Swedes and the internet* 56% of those aged 75 and older are regular internet users and 79% of children aged as young as two watch TV and videos or play games online. By the age of six, 98% use the internet. 90% of Swedes do banking online. [52] Many use mobile bank ID to identify themselves and one payment app is used by 71 % of internet users.

Implementation and uptake of digital public services is high in Sweden. 90% of internet users needing to submit administrative forms do so online. Data that are already known to the public administrations are frequently pre-filled in on forms in Sweden – for example when submitting tax declarations. When it comes to interaction with public administrations for life-events, many steps can be performed completely online.

Challenges

Sweden continues to have the second highest number of ICT specialists. There is a comparatively high share of women working as ICT specialists (20%) and Sweden ranks 6th in this respect. However, demand for ICT skilled workers exceeds supply and the gap may remain for many years. Swedish IT and Telecom Industries estimate a shortage of 70 000 ICT specialists by 2022. At the same time, the number of science, technology, engineering and maths (STEM) graduates continues to lag behind many EU countries.

Swedish businesses are embracing digitisation, but more efforts could be made to address the lack of digitisation among SMEs.

51 https://www.regeringen.se/regeringens-politik/digitaliseringsstrategin/
52 https://svenskarnaochinternet.se/rapporter/svenskarna-och-internet-2017/the-swedes-and-the-internet-2017-summary/

Actions and Initiatives

In 2017, the government adopted a national digitisation strategy for compulsory and upper secondary school. The aim is that all children have adequate digital competences by 2022. The strategy focuses on four aspects of digital skills: understanding how digitisation affects the society and the individual; using and understanding digital tools and media; ensuring critical and responsible behaviour; and enabling problem solving and translating ideas into actions. Implementing the strategy involves curricula changes and training for school leaders and teachers.

In 2018, the Swedish innovation agency piloted short university courses at advanced level for professionals in jobs which are expected to be transformed by digitisation. The courses were developed in collaboration with universities, businesses and the public sector and focused on fulfilling the skills needs of large companies as well as SMEs.

An indicator for digital maturity shows that the ICT sector, trade, other service companies and manufacturing are outperforming sectors such as construction, transport and real estate[53]. The indicator also shows that small businesses lag behind bigger ones. The government recognises that rapid digitisation has made it difficult for smaller companies to keep up with technological developments under the Smart Industry Strategy 2030 and its action plan from 2016.

The eHealth Agency works on rules and regulations, definitions and standards for more efficient and secure health care. A challenge related to the exchange of patient information is that health care is decentralised.

2.5. Cyprus

According to the Digital Economy and Society Index (DESI) 2018, "Cyprus ranks 21st out of the 28 EU Member States. Overall, Cyprus is progressing slowly but steadily. It shows improvements in all dimensions of the DESI index, and despite being ranked 21st, it is relatively close to the EU average". [54]

Cyprus ranks 19th in terms of connectivity (20th in 2017). It performs well in terms of fixed broadband and high-speed broadband coverage, as well as the penetration of fixed and mobile broadband. However, Cyprus is lagging in 4G coverage, high-speed and high-bandwidth penetration, and broadband price index. Given the investment of mobile network providers, it is likely that Cyprus will bridge the gap in the coming years. [55]

In regard to the integration of digital technologies by businesses, Cyprus is making slow progress.

53 https://www.tillvaxtanalys.se/publikationer/rapport/rapportserien/2017-05-10-digital-mognad-i-svenskt-naringsliv.html
54 Industry for Development, *The New Industrial Policy of Cyprus 2019 – 2030 [Action Plan for period 2019 - 2022].* Nicosia: 2019
55 Ibid.

Companies are using social media and e-commerce but are less willing to adopt new technologies, such as cloud computing and RFID (Radio-frequency identification). SMEs' online sales were down in 2019 compared to the previous year. On the other hand, the turnover of e-commerce has increased. Although e-commerce turnover increased (6.3%), it is well below the EU average (10.3%), as is the EU average (17.2%) and the share of SMEs online sales (11.4%) [56].

In terms of digital public services, Cyprus remains generally below the EU average (54.8 versus 57.5). Internet service integration indicator is lower than the EU average (76 versus 84), while digital public services for cross-border business remained at the level of 2016 (91 versus 83 on average). Open data has made steady progress and is at EU average levels (75% vs. 73% of EU average). The number of users of e-government services remained at the same level as last year (49% versus 58% of the EU average)[57].

Currently in the country, there is a shortage of knowledge and a lack of information from the industry about guidelines and directives on IIoT policies. That is to say everyone thinks their factories are in a very good condition and indeed are, but when we talk about Industry 4.0, we imagine something very different than just good software in a production line. Therefore, there is a lack of information, but - more importantly - there is also a lack of education and training to introduce such technologies[58].

The long-term and structural challenges in the industrial sector are the following:

Decreased competitiveness, mainly due to low productivity, high production costs and generally higher supply chain costs due to the small market size, the insular nature of the economy and geographical and energy "isolation", limited resources, low ability to innovate, the inadequate exploitation and implementation of quality standards, the lack of a holistic industrial policy and adequate infrastructure.

Obstacles to the operation and development of industry, arising from the high administrative burden, bureaucracy and lack of co-ordination of industry actions and policies.

Skills gap of human resources in relation to the real needs of the industry, which results mainly from the mismatch of skills in education with labour market, low participation in vocational education and training (VET), lack of close links between industry and research, lack of capacity to commercialize research and innovation results, and lack of a culture of employment in industry.

Lack of strategic investment in industrial activities and Research & Innovation mainly from the private sector.

56 Ibid.
57 Ibid.
58 Ibid.

Difficult to access financing, mainly due to the lack of alternative financing and the strict regulatory lending framework of banks.

Inadequate coordination between competent departments to fully exploit export opportunities.

Lack of culture of strategic cooperation between businesses, in the areas of production, distribution, export, and others[59].

Cyprus must and can be at the heart of the digital world economy by:

1) Digitally empowering its competitors, such as tourism, and combining them with others not as competitive, such as health and education
2) Investing in innovative ideas and new products
3) Using open data, with a measurable goal of making a positive contribution to the national GDP
4) Seeking to have an application centre in the wider area of artificial intelligence
5) Rapidly adopting new generation (5G) networks that provide the technology platform and high speeds needed to operate reliable applications such as autonomous driving, smart cities and advanced industry, education and health
6) Seeking to develop into new areas, such as Blockchain, as a regional centre of excellence in the Eastern Mediterranean
7) Adopting the digital world in the whole of public administration and encouraging its adoption by all citizens and their activities
8) Encouraging young people, in particular women, to acquire the appropriate new skills or to pursue science, technology, engineering and mathematics (STEM)
9) Establishing the appropriate regulatory framework for controlling algorithms and their impact to avoid possible risks to human privacy and autonomy. [60]

A catalyst in this endeavour, as demonstrated by a recent study by Accenture, is the creation of a national hyper-platform, which will act as a link and access point to existing and new platforms.

It is crucial to encourage businesses to innovate by introducing new technologies and focusing on digital technology, but also to establish a labour market quota. Furthermore, it is important to enhance the competitiveness of businesses by implementing smart production and innovation systems. [61]

59 Plecher, H. (2018) *Cyprus – Statistics & Facts*. Statista. Retrieved from: https://www.statista.com/topics/4191/cyprus/
60 Ibid.
61 Republic of Cyprus, *Blockchain: Cyprus National Strategy*. Nicosia: 2019. Retrieved from: http://mof.gov.cy/assets/modules/wnp/articles/201907/480/docs/blockchain_ypoyrgoy.pdf

2.6. Italy

In Italy, the IIoT is experiencing a phase of great expansion, with most companies having implemented this type of technology or about to do so. On the other hand, however, there are also companies that do not seem to have any interest in implementing IIoT, neither now nor in the future.

In the latter case, the main challenge is related to the following approach: on the one hand, companies that are not interested believe that the IIoT is not necessary or a priority within their company, although there are also elements such as lack of skills for implementation and maintenance, economic reasons and data protection concerns. On the other hand, there are significant benefits among companies that have embraced IIoT, including increased productivity, increased process efficiency, cost savings, simplified logistics, reduced delays or interruptions in production, and improvements in product quality. However, some critical issues remain, including the fact that the cost and complexity of the systems, together with the cost of deployment, are obstacles to the implementation of IIoT. The increasing number of connected devices is also creating difficulties for the IT departments of companies, which are having to deal with problems in ensuring data security, maintenance due to the specific skills required and working together on different products.

Overall, therefore, it is clear that the IIoT in Italy is already well established and has become an integral part of the production structure. Although this is an excellent result, the number of companies that seem to have not decided to embrace IIoT is a cause for concern as it means that they will lose competitiveness in the medium and long term.[62]

Italy ranks 24th out of the 28 EU Member States in the European Commission Digital Economy and Society Index (DESI) 2019. [63] Italy performs relatively well, although still below the EU average, as regards Connectivity and Digital public services. Online public services and open data are readily available, and take-up of e-health services is good. Fast broadband coverage and take-up are progressing well (although the latter remains below the EU average), while ultrafast connectivity is progressing far more slowly. Italy is advanced in the assignments of 5G spectrum.

However, three out of ten Italians are not regular internet users yet, and more than half of the population still lacks basic digital skills. This shortfall in digital skills is also reflected in low use of online services, in which little progress has been made. Low demand also affects supply, with fewer Italian SMEs selling online than their EU peers. However, Italian enterprises score better on the use of electronic information-sharing software and social media.

62 https://techfromthenet.it/2020/04/14/per-reichelt-in-italia-c-e-sempre-piu-internet-of-things/
63 Data from the European Commission Digital Economy and Society Index (DESI) 2019, at https://ec.europa.eu/digital-single-market/en/desi.

In 2017, the "WiFi Italia it" project was launched to enable users to connect easily to a free of charge and widespread WiFi network throughout the country through the use of an application for mobile devices that provides access to federated WiFi networks. The Interministerial Committee for Economic Programming, CIPE, decided to allocate about EUR 100 million to developing WiFi and new technologies (such as Artificial Intelligence, the Internet of Things and blockchain). Of this sum, EUR 5 million have been earmarked for phase II of the wifi.italia.it project, which will extend the footprint of the WiFi network, with a focus on the areas hit by the violent earthquake of 2016 and on further developing the wifi.italia.it app.

In the Human capital dimension, Italy ranks 26th among EU countries and is thus below the EU average. The basic and advanced digital skills levels of Italians are below the EU average. Only 44 % of people aged 16-74 years have basic digital skills (57 % in the EU as a whole). The percentage of ICT specialists has remained stable. ICT specialists still account for a lower proportion of the workforce compared with the EU as a whole (2.6 % compared with an EU average of 3.7 %). When it comes to graduates holding an ICT degree, Italy performs well below the EU average with only 1 % of ICT graduates. Only 1 % of female workers are ICT specialists.

Italy adopted the national Digital Agenda Strategy 2014-2020 and the National ultra-broadband Strategy in March 2015. In September 2016, Italy developed its Industry 4.0 Strategy, renamed 'Impresa 4.0' in 2017 to emphasize its broader scope, as it includes service sector enterprises as well as industry. The current government has confirmed that the Industry 4.0 Strategy will be continued (with some and/or modified measures). It is also providing renewed support for the Digital Agenda Strategy through a more active political steering.

2.7. Latvia

Latvia ranks 17th out of the 28 EU Member States in the European Commission Digital Economy and Society Index (DESI) 2019. [64] Its score increased due to a slightly improved performance in some of the DESI dimensions. Latvia performs well in Digital public services and Connectivity thanks to the wide availability of fast and ultrafast fixed and mobile broadband networks and the increased take-up of e-government services.

However, the Latvian business sector still scores below the EU average on the Integration of digital technology and also on the Human capital dimension. Nearly half of the population still lacks basic digital skills and the supply of ICT specialists has not kept pace with growing demand in the labour market. Latvia has made most progress with Digital public services. However, it is a long way behind as regards the Use of digital technologies by businesses, with Latvian enterprises failing to make use of the opportunities offered by e-commerce. They are also far below the EU average in their use of social media.

64 Ibid.

Among all dimensions, Latvia scores best in e-government. Progress is driven by the growing number of Latvians who actively use e-government services and by the increased availability of pre-filled forms and open data.

CBL Asset Management, a subsidiary of Citadele Bank, has conducted a study on what to consider when preparing for the 4.0 industry in Latvia. It turns out that only 36% of respondents believe they have the skills they need to succeed in the 4.0 industry. This coincides with the DESI data, wherein in terms of human capital, Latvia ranks 21st among EU countries and below the EU average, with indicators showing no relevant progress in the last few years. Although increasing numbers of Latvians are going online, basic and advanced digital skills levels remain well below the EU average. Only 48 % of people have basic digital skills (57 % in the EU as a whole) and the gap between Latvia and other EU countries is even wider for advanced skills. However, most respondents are on the right track, demanding and expecting these skills and training from their employer. According to a study, 39% of respondents believe that it is businesses that should prepare them for robotics and artificial intelligence.[65]

Anticipating the skills that will be required to succeed in the 4.0 industry (not to mention specific technical skills), the most important skill will be the ability to adapt and learn, and not be confused in an ever-changing and sometimes chaotic environment. Skills such as the ability to articulate ideas and the ability to focus are emphasized. Particular emphasis is placed on seeing relationships and intuition.

In a survey [66]of Latvian companies, 33.3% of companies expect significant changes and 40% - minimal changes, while 26.7% of companies do not forecast changes due to the introduction of industry 4.0. The major challenges facing industry 4.0 in the companies surveyed are: lack of technology application experience (65.5%), lack of specific knowledge among employees (65.5%), cost overruns (56.8%), compatibility issues with existing processes and technologies (41.4%). In DESI lists Latvia ranks 24th among EU countries with regard to integration of digital technology by businesses, which well below the EU average.

One of the most important barriers to change is the skills level of employees. 57.6% of companies indicate that the company needs employee training to implement industry 4.0. The key soft skills required for the implementation of Industry 4.0 are the ability to innovate (83.3%) and the willingness to acquire new knowledge (70%).

According to the survey, industry professionals must have the following professional skills to succeed in Industry 4.0:

65 2018 Deloitte Millennial Survey Millennials disappointed in business, unprepared for Industry 4.0 Available at: https://www2.deloitte.com/content/dam/Deloitte/global/Documents/About-Deloitte/gx-2018-millennial-survey-report.pdf
66 Available at: http://change4industry.eu/news/99/555/73-3-MAsiNBuVES-UN-METaLAPSTRaDES-UZneMUMU-PROGNOZe-PaRMAInAS-IEVIEsOT-INDUSTRIJU-4-0.html

1) 83.3% technical skills, including technologies, new materials
2) 80% of electrical and mechanical competence, including programming equipment, use and control of measuring devices, integrated controls
3) 80% robotics, including IT aspects related to technology monitoring
4) 70% IT skills, including software maintenance
5) 56.7% knowledge management, including knowledge sharing and development
6) 50% advanced technology, including 3D printing
7) 46.7% large volume data processing and analysis
8) 36.7% privacy, including user rights, IT infrastructure
9) 30% social skills, including collaboration and communication
10) 20% media literacy, including social media, mobile devices
11) occupational safety, functional safety of equipment, decentralized process management

Despite the rising numbers of ICT graduates and the associated policy efforts, such as the activities supported by the Digital Skills and Jobs Coalition, Latvia would benefit from further sustaining motivation for life-long learning, raising awareness of the relevance of digital skills in the labour market and encouraging enterprises to invest in these skills. Higher levels of digital skills among the general public will make the country's labour market more inclusive while also boosting business productivity.

3. SITUATION AND TRAINING NEEDS IN IIOTNET IN SIX EU COUNTRIES

3.1. METHODOLOGICAL OUTLINE OF THE EMPIRICAL RESEARCH

The IoT refers to the not far future with wireless inter-connectivity between objects and everyday devices by creating intelligence systems that transfer and exchange data without the need of human-to-human interaction.

IIoT is devoted to adopting the IoT to enable the interconnection of anything, anywhere, and at any time in the manufacturing system context to improve the productivity, efficiency, safety, and intelligence. As an emerging technology, IIoT has distinct properties and requirements that distinguish it from consumer IoT generally, including the unique types of smart devices incorporated, network technologies and quality of service requirements. Industrial companies have to develop robust organizational structures that support data analytics as an enterprise-level capability.

In order to assess the situation and the training needs in all six partner countries, the first step was to define the methodology, instrument, content and general set-up on national IIoT initiatives and policies. For this task, a survey was developed, which consisted of an analysis of the IIoT state of art, including an analysis of the different available providers, technologies and applications connected to IIoT, as well as future trends, and an analysis of the awareness of the existing IIoT technologies and applications in the corporate sectors. The survey focused on questions such as knowledge/awareness of general issue, risks/problems in strategy developed, needs and demands for external support in training and consulting measures, suggestion for training interventions.

The survey consisted of four distinct parts or blocks. The 1st block contained questions for the assessment on the understanding of the concept of IoT. The 2nd block had questions on the background of the participant and the IIoT (application, obstacles for implementation, etc.). The 3rd block was designed to assess training and certification needs with regard to IIoT, and the last block had questions specifically on IIoT (e-notes, network creation, etc.)

The questionnaire was prepared in English, Bulgarian, Latvian, Italia, Swedish, and Greek, with 47 questions altogether. The overall aim of the survey was to find out the organization situation in relation to Industry 4.0 in particular Industrial IoT (IIoT) technologies. The target groups of the online survey were decision makers, experts, professionals and VET providers related to the IIoT field.

The online questionnaires were sent out via emails to the contact persons of large companies, SMEs, associations, VET providers; in addition, telephone interviews were conducted with the representatives of the main target groups.

Different target groups were reached out to in order to collect the relevant information about the current situation regarding Industry 4.0, the state of digitalisation, the training needs, and any recommendations. Through a large network at regional and national level and working in close cooperation with large companies, SMEs, VET providers, universities, colleges, local authorities, professionals and associations, 699 surveys were collected, filled in by the representatives of abovementioned target groups:

1) Bulgaria – 150 respondents
2) Greece – 104 respondents
3) Sweden – 102 respondents (16 online)
4) Cyprus – 106 respondents
5) Italy – 116 respondents.
6) Latvia – 121 respondents.

Currently, there is a lack of information on IIoT in most partner countries. According to the empirical research and online survey, which will be analysed in the next chapter, most countries lack information, knowledge and training on the IIoT for introducing effectively Industry 4.0 and its technologies in the various sectors of the countries.

Nevertheless, with appropriate efforts put in in an effective IIoT education and training, each country can benefit from the digital economy and society because of its rich reserves of know-how, science, determination and hard work that enables the countries to not only be modernized and to keep up with the new smart age, but also to pioneer new advances in the relevant field. Knowledge of the IIoT and use of it will serve as a competitive advantage for each country, as the digital age provides easy and fast dissemination of information and a seamless transfer of purpose and overall vision.

3.2. Analysis of the survey

3.2.1. BULGARIA

In Bulgaria, the questionnaire was sent to 200 representatives of the target group and 150 of them responded. Part of the respondents (70) filled the digital form and the rest (80) answered by e-mail. The target group was divided as follows: Associations— 36 respondents; University/College – 32; VET providers- 27; SMEs- 18; Large companies – 14 and other – 23 (table 15)

The industries represented were as follows:

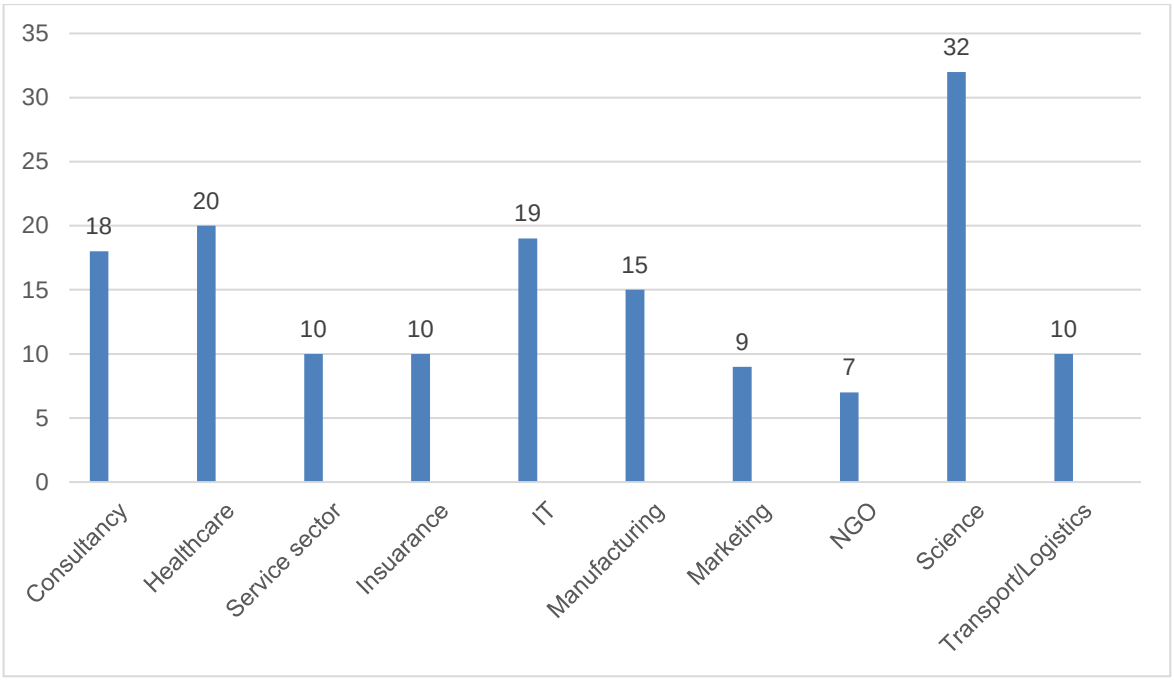


Figure 24

The representatives who answered that they own IoT product/s were 92 (61%), another 51 representatives answered with "No" (34%) and 7 of respondents answered "I don`t know" (5%).

The products used were as follows:

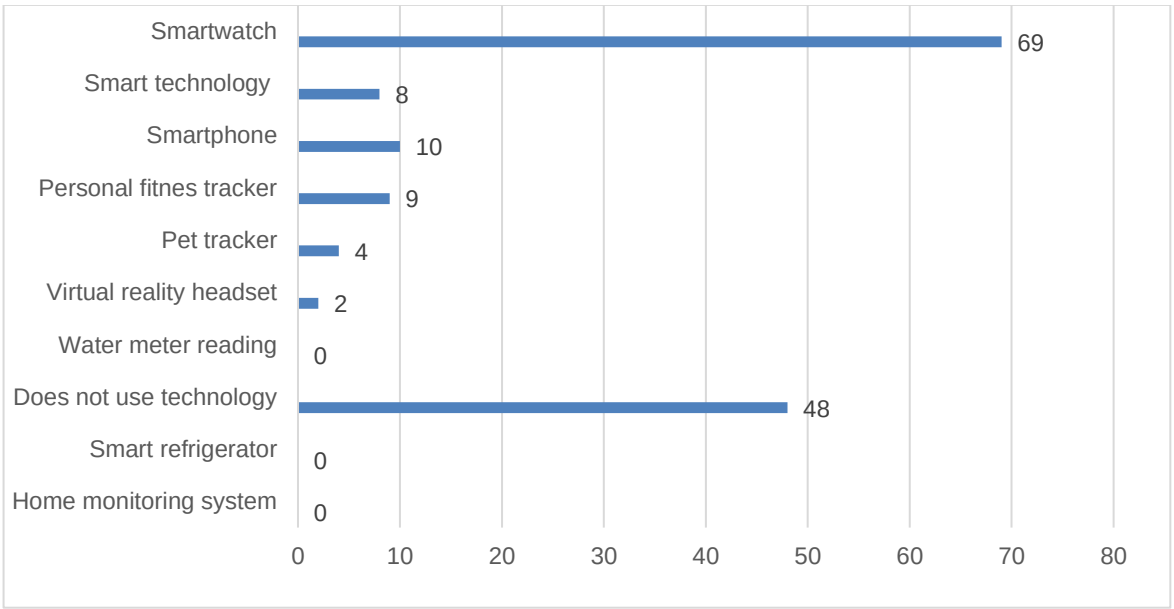


Figure 25

Most of the respondents were sure that IIoT would help them or their enterprise to improve their service.

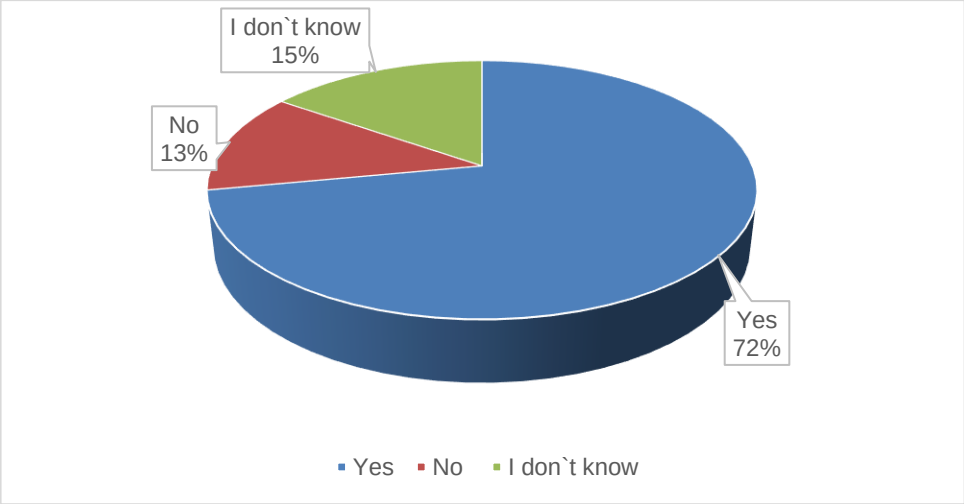


Figure 26

Table 6

Please choose the most suitable answer, rating from 1 - 5 with "1" being the lowest and "5" the highest	1	2	3	4	5	No opinion
How important is the usage of technology in your job?	2	3	12	29	98	6
How important are the IT skills in your job?	3	6	11	42	83	5
How able are the SMEs in your country to train their own personnel?	19	17	54	18	14	28
How able are the large companies in your country to train their own personnel?	17	19	43	29	17	25
How able are the VET providers in your country to deliver complete IIoT training?	16	18	33	29	25	29
How important is a continuous training for an employee?	7	23	32	38	33	18
How often IIoT VET courses are taking place in your sector?	22	27	34	20	16	31
How open are the SMEs in your country regarding the IIoT training?	23	26	42	17	10	32
How open are the large companies in your country regarding the IIoT training?	20	27	30	31	14	28

How aware the corporate sector in your country is regarding the IIoT?	13	23	44	18	20	32
How important is the external consulting for an SME regarding IIoT?	9	26	35	30	22	28
How important is the external consulting for a large company/association regarding IIoT?	10	23	31	29	28	29

The following questions were answered only by those persons who already use IIoT products. In Bulgaria they are 81 out of the 150 respondents.

Question 31: Which industry is related to your knowledge/interest about IIoT products?

58 % indicated Science, technology, education, 30 % - Health, and 12 % - Manufacturing, followed by Transport and Other.

Question 32: Do you think that for IIoT in your industry, we need to specify in more details the types of used sensors (IIoT devices)?

- Yes: 55.5 %
- No: 39.5 %
- Other: 5 %

Question 33: Do you think we need to create a regular e-notes, distributed to the members of IIoT, via subscription Network?

- Yes: 72 %
- No: 17 %
- I do not know: 11 %

Question 35: If regular distribution of e-notes is provided, who should be responsible for the creation and the distribution?

- On the elected management board of IIoT Network – a special designated person: 36 %
- On the Industry level of the IIoT Network – a special designated person: 54 %
- Other: 10 %

Question 36: How do you see the creation of IIoT Network in Europe?

- On the EU level: 38 %
- On the level of the participating countries to this project at the initial stage: 22 %
- Only on a national level: 14 %
- On the technology pillow level of the IIoT: 26 %

- Other

Question 37: To support the IIoT Network, we will use a dedicated private Social Network. What kind of functions of this Social Network do you envisage to be the most important to facilitate the IIoT Network?

- Creation of groups per Industry IIoT: 4 %
- Creation of levels of management for each group of interest: 11%
- Creation of groups per technology: 75 %
- Creation of groups per interest at EU level: 6%

Question 38: How would you prefer to conduct the meetings of the IIoT Network?

- Only with e-Meeting tools: 41%
- At least once per year to meet physically in a specific country/town: 56%
- Other: 3%

Question 39: Do you envisage to have promotion of products / services related to IIoT members on the Website for free, with link to the provider's site? (this will require some small payment to a person supporting this dynamic functioning of the Website)

- Yes: 19%
- No: 35%
- I don't know: 46 %

Question 40: Please select the core functions (possible more than 1) of the IIoT Network that we envisage to establish:

- Link between IIoT producers: 8%
- Link between IIoT service providers: 22%
- Link between IIoT VET: 14%
- Link between IIoT University / College educators: 16%
- Link between IIoT end-users (Industry corporations) and appropriate creators / service providers / consultants: 20%
- I don't know: 15%
- Other: 5%

Question 41: How can the Big Data environment (e.g. Hadoop systems) support the IIoT?

- On a large scale for a full data analysis of IIoT data: 41%
- The main IIoT data will be stored there: 9%
- Only the big files from IIoT will be stored there: 18%

- Only some data will be stored: 2%
- We do not plan to use Hadoop system for repository of IIoT data: 3%
- I don't know: 27%

Question 42: From the main 4 focused Industries, which one will generate the biggest amount of data?

- Manufacturing: 25%
- Health care: 25%
- Transport: 20%
- Science, technology, education: 30%
- I don't know: 0%

Question 43: Which industry will generate new data with biggest frequency?

- Manufacturing: 25%
- Health care: 25%
- Transport: 20%
- Science, technology, education: 30%

Question 44: Which type of network do you expect to use for transferring the data from IIoT devices?

- LoRa: 0
- 4G – GSM: 15%
- 5G: 55%
- Industrial WiFi: 20%
- I don't know: 0%
- Other: 10%

Question 45: Do you expect a special ICT architecture to collect the data from your IioT?

- No: 52%
- Yes: 48%

Question 46: Do you expect to use a special methodology for collection of data from IIoT devices?

- No: 61%
- Yes: 39%

Question 47: Do you see any role of Industry 4.0 in the creation of IIoT Network?

- No: 15%

Yes: 85%

3.2.2. GREECE

104 persons participated in the targeted survey questionnaires sent by the Greek IoT partners. Following the compilation and analysis of the results, it was concluded that small and medium size enterprises (31.7%) and VET providers (26%) were the main respondents of the survey, followed by Universities/Colleges (15.4%), Large enterprises (11.5%), Other (11.5%) and Associations.

The respondents represented the following industries: science, technology and education (51.9%), manufacturing (16.3%), other (16.3%), followed by transportation and logistics and health care.

To the question on *"How many years of experience do you have in the sector?"*

- 32.7% of the respondents answered more than 10 years,
- 28.8% of the respondents answered 1-5 years,
- 26.9% of the respondents answered 6-10 years and
- 11.5% of the respondents answered less than a year.

When assessing the IoT affiliation of respondents, 53.8% stated that they own an IoT product, followed by 40.4% that answered that they do not. 104 survey respondents specified which IoT technology they use; most of them (42) replied "Other", followed by personal fitness tracker (30), smart watch (36), smart thermostat (8) and smart refrigerator (6).

With regard to their knowledge of IIoT, 49% of the respondents answered that "it is the application of IoT in Industry, which allows monitoring and control of industrial "things" and processes", 19.2% replied that "it is something to do with Industry and IoT" and 31.7% answered that they know "nothing".

The majority of the respondents (56.7%) identified the benefits from IIoT as it "can optimize industrial processes, can improve the production of goods and lead to better quality products and services, to more efficient solutions", 26% answered that they do not know and 10.6% answered that it "might help somehow in some industry applications". Survey results show that although most respondents (58.7%) think that the IIoT would help them and/or their enterprise to improve their service, a considerable number of them do not know if IIoT would help (remaining 39.4%). Most of the respondents (38.5%) identified problems linked to standards, security and applications of IIoT in the particular sector. The biggest obstacles for SMEs in the implementation of IIoT were considered to be the following:

- Lack of information (need for education, training) (57 answers)
- Lack of funding (25 answers)
- Lack of interest on the part of management (10 answers)
- Other (I do not know) (10 answers)

- There are no obstacles for SMEs in the implementation of IIoT (2 answers)

Replies to the question "*In what sector do you believe that the IIoT would be more important?*" do not allow to draw a specific conclusion as 29.8% respondents indicated Science, Technology & Education, 23.1%—Health Care, 21.2%—Manufacturing, 15.4%—Transportation & Logistics, and 9.6%—Other.

Most of the respondents (37.5%) identified the strategy needed for the introduction and implementation of IIoT to be "education and training in the enterprise", followed by 25% who think that the best strategy would be the "exchange of experience with enterprises that already implement it". Other replies were "I do not know" and "Need a digital officer and department to implement IIoT".

51% of the respondents answered that "the IT department, digital officer together with the management" should formulate the objectives of IIoT, 29.9% did not know and 16.3% answered that the objectives should be formulated by the management. 57.7% of the respondents answered that enterprises "have to analyse the objectives, map them to the available technologies and the budget and follow the priorities".

The vast majority of Greek respondents (76%) answered that they do not know of the national Industry 4.0 policy and 19% answered that such policy does not exist. Similarly, 80.8% did not know of national IIoT policies and only 12.5% answered that "heard of a few things in this area". 84.6% were not aware of training initiatives at national level regarding IIoT/IoT, compared to only 8.7% that replied that such initiatives exist.

The need for consultancy and training in IIoT ranked particularly high: 70.2% of the respondents answered that they "need full training and courses on all issues related to IIoT" and 26.9% answered that they "need some courses and training on some issues of IIoT", with only the remaining 2.9% claiming that they do not need training as they know all about it. 68.3% of the respondents believe that the most efficient way of training is a mix of face to face with e-learning, followed by 17.3% who support face-to-face learning and 13.5% who support e-learning. Regarding the certification that should be provided after the training, 27.9% of the respondents answered that a "certificate with recommendation / granted rights to continue with additional VET Training" should be provided after any such training, 22.1% answered that a "certificate with achieved results" should be provided, 19.2% answered "certificate of attendance" and 15.4%—"certificate with a recommendation for work (be appointed) in a IIoT company from a particular industry".

The following questions allow a better understanding of IIoT trainees needs (with 1 being the lowest and 5 being the highest value):

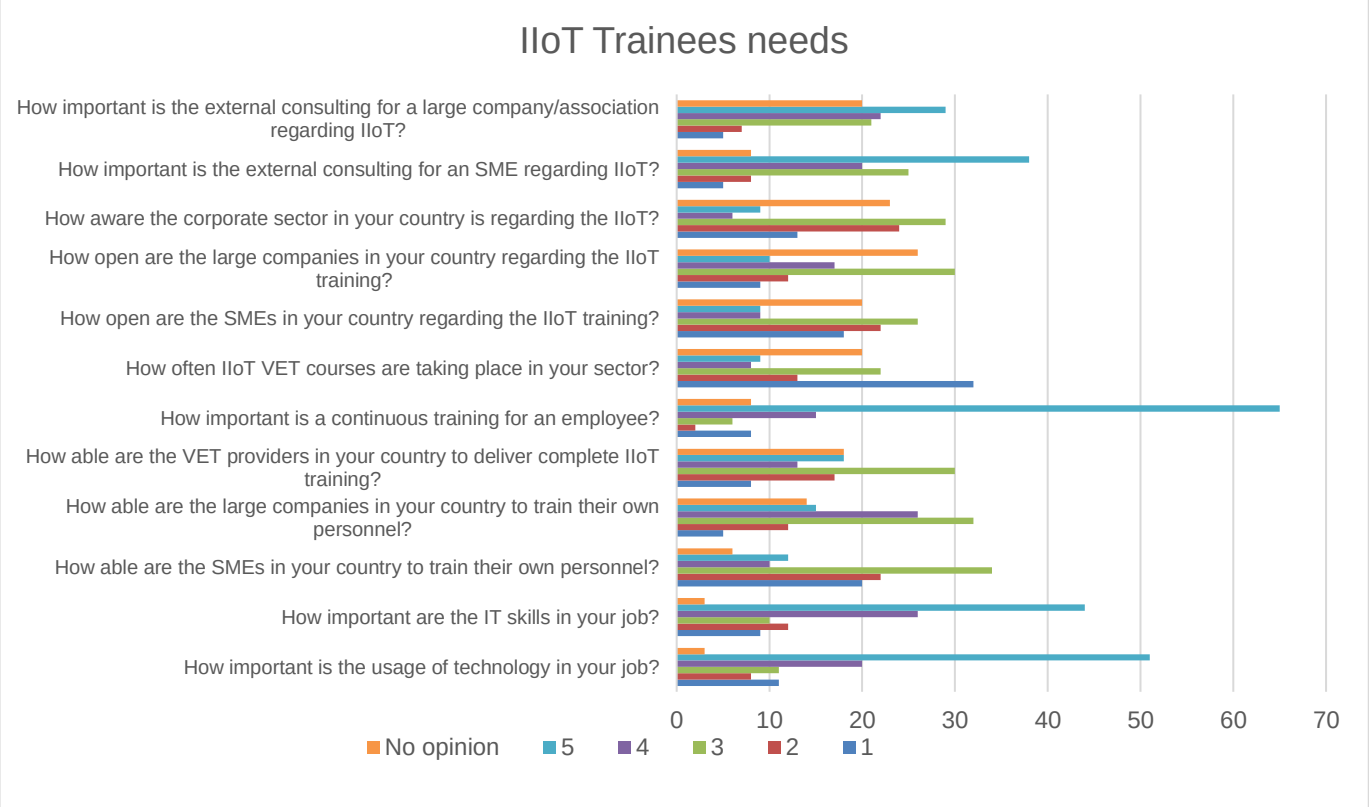


Figure 27

The following questions were answered only by those persons who already use IIoT products. In the Greek case, they are 55 out of the 104 respondents.

Question 31: Which industry is related to your knowledge/interest about IIoT products?

61.8% indicated Science, technology, education, 14.5% - Health, and 12.7% - Manufacturing, followed by Transport and Other.

Question 32: Do you think that for IIoT in your industry, we need to specify in more details the types of used sensors (IIoT devices)?

- Yes: 43.6%
- No: 47.3%
- Other: 9.1%

Question 33: Do you think we need to create a regular e-notes, distributed to the members of IIoT, via subscription Network?

- Yes: 70.9%

- No: 14.5%
- I do not know: 14.6%

38.2% of the persons responded that they believe that the distribution should be quarterly, 32.7%—monthly, 9.1%—annual and 9.1%—half-yearly.

Question 35: If regular distribution of e-notes is provided, who should be responsible for the creation and the distribution?

- On the elected management board of IIoT Network – a special designated person: 32.7%
- On the Industry level of the IIoT Network – a special designated person: 56.4%
- Other: 10.9%

Question 36: How do you see the creation of IIoT Network in Europe?

- On the EU level: 41.8%
- On the level of the participating countries to this project at the initial stage: 23.6%
- Only on a national level: 14.5%
- On the technology pillow level of the IIoT: 16.4%
- Other

Question 37: To support the IIoT Network, we will use a dedicated private Social Network. What kind of functions of this Social Network do you envisage to be the most important to facilitate the IIoT Network?

- Creation of groups per Industry IIoT: 2%
- Creation of levels of management for each group of interest: 13%
- Creation of groups per technology: 63%
- Creation of groups per interest at EU level: 16%

Question 38: How would you prefer to conduct the meetings of the IIoT Network?

- Only with e-Meeting tools: 47.3%
- At least once per year to meet physically in a specific country/town: 47.3%
- Other: 5.4%

Question 39: Do you envisage to have promotion of products / services related to IIoT members on the Website for free, with link to the provider's site? (this will require some small payment to a person supporting this dynamic functioning of the Website)

- Yes: 21.8%
- No: 29.1%
- I don't know: 49.1%

Question 40: Please select the core functions (possible more than 1) of the IIoT Network that we envisage to establish:

- Link between IIoT producers: 12%
- Link between IIoT service providers: 19%
- Link between IIoT VET: 18%
- Link between IIoT University / College educators: 18%
- Link between IIoT end-users (Industry corporations) and appropriate creators / service providers / consultants: 24%
- I don't know: 8%
- Other: 1%

Question 41: How can the Big Data environment (e.g. Hadoop systems) support the IIoT?

- On a large scale for a full data analysis of IIoT data: 35%
- The main IIoT data will be stored there: 7%
- Only the big files from IIoT will be stored there: 11%
- Only some data will be stored: 7%
- We do not plan to use Hadoop system for repository of IIoT data: 5%
- I don't know: 35%

Question 42: From the main 4 focused Industries, which one will generate the biggest amount of data?

- Manufacturing: 17%
- Health care: 19%
- Transport: 14%
- Science, technology, education: 35%
- I don't know: 15%

Question 43: Which industry will generate new data with biggest frequency?

- Manufacturing: 14.5%
- Health care: 20%
- Transport: 9.1%
- Science, technology, education: 56.4%

Question 44: Which type of network do you expect to use for transferring the data from IIoT devices?

- LoRa: 0
- 4G – GSM: 12.7%

- 5G: 38.2%
- Industrial WiFi: 9%
- I don't know: 12.7%
- Other: 27.4%

Question 45: Do you expect a special ICT architecture to collect the data from your IioT?

- No: 67.3%
- Yes: 32.7%

Question 46: Do you expect to use a special methodology for collection of data from IIoT devices?

- No: 72.7%
- Yes: 27.3%

Question 47: Do you see any role of Industry 4.0 in the creation of IIoT Network?

- No: 61.8%
- Yes: 38.2%

3.2.3. SWEDEN

The result of the Swedish survey indicates that a lot Swedish respondents own an IoT product like a smartwatch, fitness tracker (52%). All most of them have an IoT device only 6% doesn't. The majority uses an app to control their smart device (67%). Concerning level of interest for IoT and social media the respondents are interested and active. All the respondents think they live in a technologically advanced country and know about with IoT. The only thing that differ is the level how technically advanced the country is.

They represent different sectors of the society, both private and public, and have long experience of their sector (82% with over 10 years' experience). They know about IIoT and the benefits of it and sees the advantage of it for their company/organisation. The biggest problem is the lack of standard in the area (63%) and an implementation issue is lack of information (60%) and some degree lack of funding (12%).

Table 7

Target groups	Respondents	Percentage
Large companies	20	19,61

Associations	16	15,69
SMEs	40	39,22
VET Providers	11	10,78
University/College	2	1,96
Other	13	12,75
Total	102	100,00

The sectors they point out that IIoT will be more important is hard to determine though almost all points out several sectors and they see the need for exchange experience and guidance of a digital officer in their organisation.

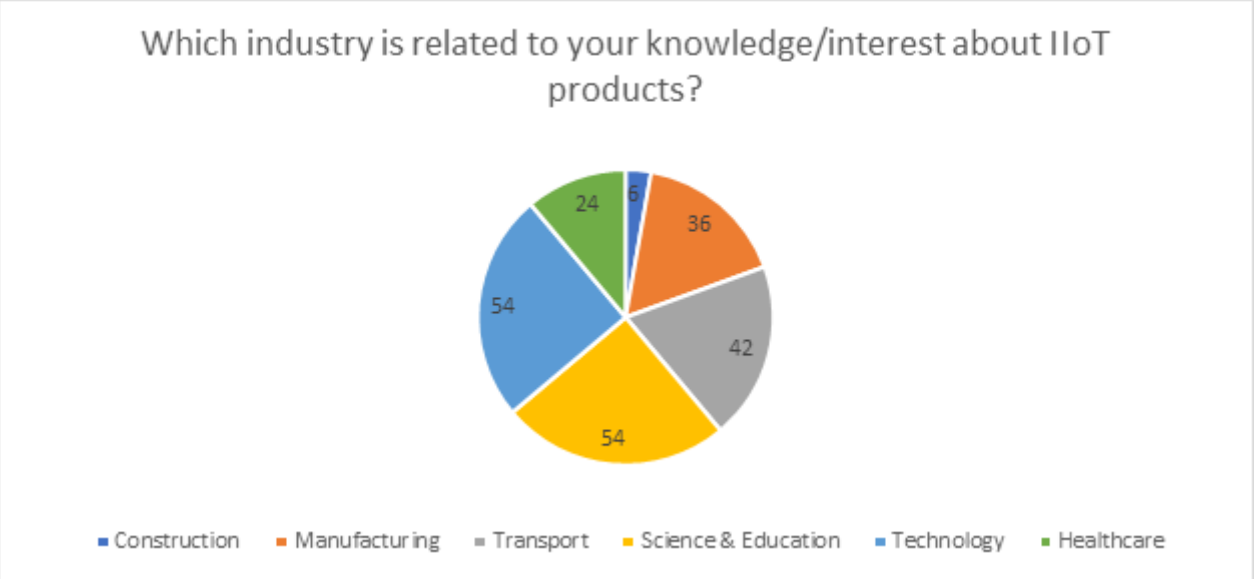


Figure 28

The management is involved in setting objectives for IIoT (66%) and are aware the needs of mapping the current used technologies.

Awareness of national policies is low (12% Industry 4.0 and 24% National strategy for IoT), but they see it as a factor of implementing IIoT. Other factors are of course investments both in knowledge and technology. Strengths are based on experience and knowledge in their organisations and needs are harder to summarise thou it differs a lot.

Almost all participants rank importance of usage of technology in their job high (94%) as well as IT skills (54%). Answers about training of staff differs a lot between the respondents from high to low with a majority in the middle. Most of them think it is very important with continuous training of staff and most companies are open and aware to IIoT training.

Most organisations think a combination of online and face to face training is the best. There are just a few companies that have training initiatives ongoing concerning IIoT and few are aware of any national initiatives. Most of them prefer a certificate of attendance after a course. A majority already use IIoT in their position today and their interest is in their field of work. An interest of e-notes from our project is detected and they want it to a specific person/role in their organisation. There is an interest in E-meetings on national level and with some physical meetings yearly. They want it as a link between users, educators, producers and universities.

Concerning the level of produced data, the respondent's high lights Health care, Science and Technology and the usage of 5G and Industrial WiFi. No special ICT architecture or methodology needed according to the respondents and they don't see the connection to Industry 4.0.

Conclusion

Sweden is among the top five countries in terms of digital maturity in the European Union. The IIOT is essential to be introduced in all sectors of the country, now there is a focus on Industry, Bank services and lately Healthcare. The respondents are aware of the benefits of IIoT and its possibilities to rise the level off effectiveness in different sectors of society. The see some obstacles of implementing IIoT concerning standards and training the staff as well as the lack of trained professionals in IIoT in the country.

There is an interest of implementing IIoT and to train staff in how to use IIoT and getting continues updates and information from IIoTNET project.

3.2.4. CYPRUS

The 106 responders of the online survey in Cyprus came from large companies, associations, SMEs, VET institutions and universities/colleges.

The online survey analysis shows a total of 106 responders, coming mostly from large companies (32.4%), SMEs (26.5%) and VET providers (17.6%), while the rest comes from associations (11.8%) and universities/colleges (8.8%). The vast majority of the responders in Cyprus represent the industry of science, technology and education (58.8%), while less represent the industry of manufacturing (14.7), health care (8.8%) and the service provision sector (8.8%) (Figure 29). The responders' experience in their sectors was equally distributed among 1 to 5 (32.4%), 6 to 10 (29.4%) and 10 plus (32.4%) years of experience.

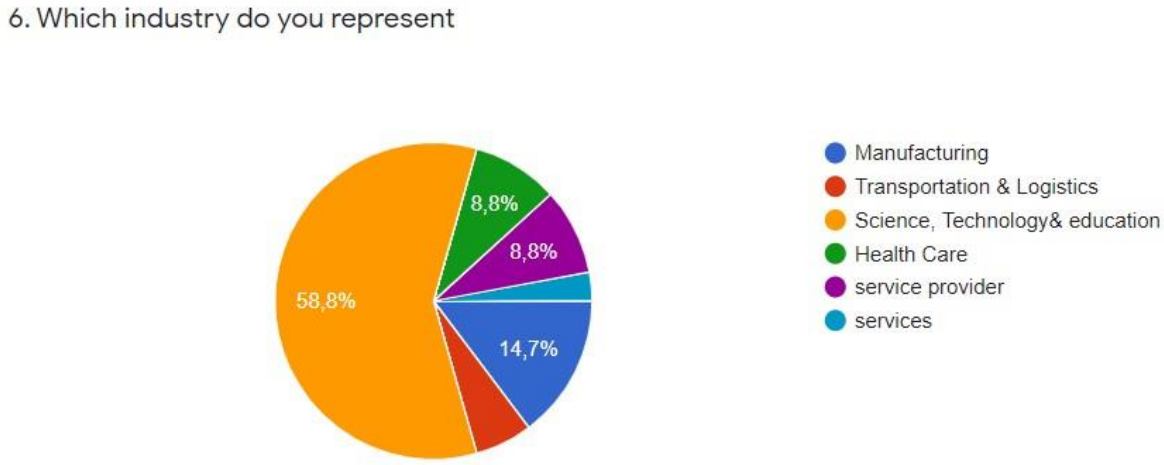


Figure 29

Based on the analysis, 52.9% of the responders own an IoT product, while 44.1% do not own any. From the ones owning a product, 76.2% use an app to manage their device(s), versus 19% who do not use one. Most common IoT owned devices include smartwatch (77.8%), personal fitness tracker (38.9%) and virtual reality set (16.7%). When it comes to the personal usage of technology and the Internet, as Figure 30 shows, the vast majority of the respondents claim that technology has a very significant role in their current life (79 out of 106), that they are very dependent on it for ease of communication (80 out of 106), that they are very active on social media (73 out of 106), and that their peers influence the way they utilise technology and the Internet (100 out of 106). On the other hand, the results show that 58 out of 105 responders state that Cyprus is not such an advanced country technologically, with 44 of them stating that it is quite advanced. Lastly, 45 out of 106 of the responders were quite familiar with the IoT prior to the survey and 44 of them were not very familiar.

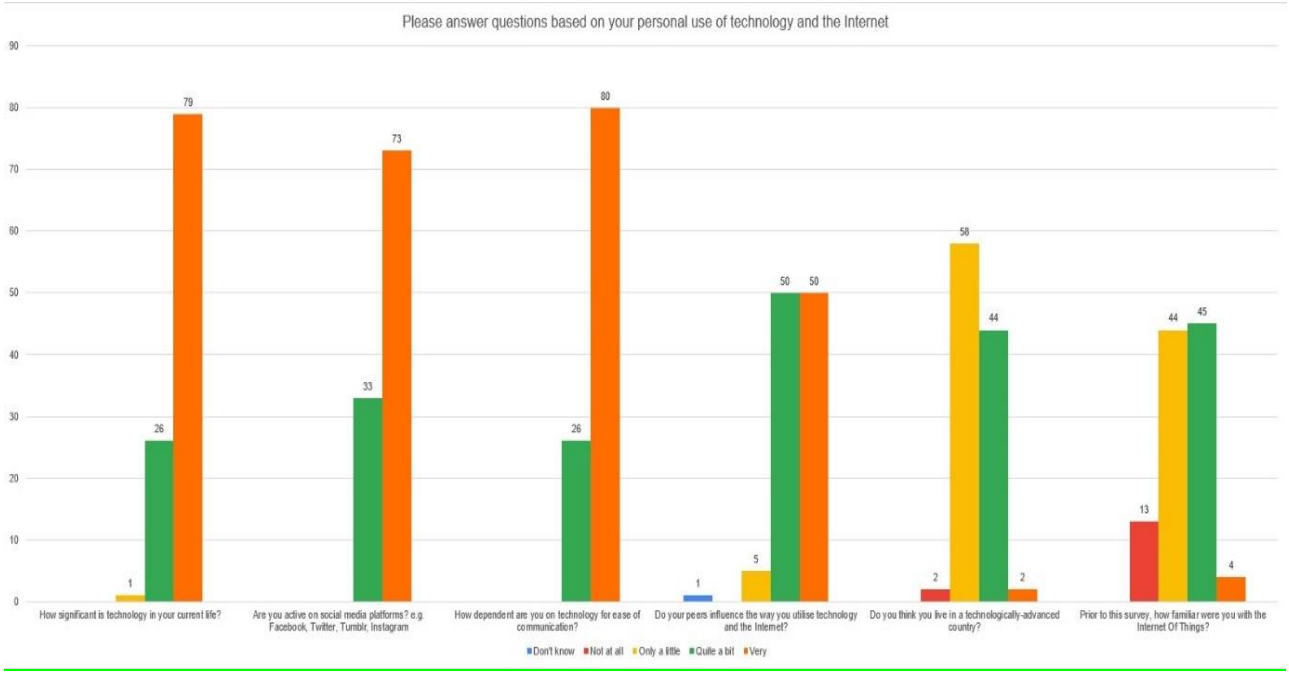


Figure 30

In terms of the respondents' knowledge regarding the term 'IIoT', most of them stated that they did not have any knowledge of the term (44.1%), while 32.4% responded that they have a general idea of the term ('It has something to do with Industry and IoT') and 23.5% responded that they had a full image of what IIoT is ('It is the application of IoT in Industry, which allows monitoring and control of industrial 'things' and processes'). When it comes to the benefits of the IIoT, 41.2% claimed to be ignorant of the benefits, while a 35.3% had a vague idea ('Might help somehow in some industry applications') and 23.5% showed full knowledge of the IIoT benefits ('Can optimize industrial processes, can improve the production of goods and lead to better quality products and services, to more efficient solutions').

When asked, most of the respondents stated that they believe IIoT would help them and their enterprise to improve their services (47.1%), but 62.9% claimed to be ignorant on if and how the IIoT can improve their companies. On the same note, most of the survey participants showed ignorance of the problems of the IIoT (55.9%), with only 29.4% claiming a general knowledge on the IIoT problems ('Problems with the application of IoT in Industry'), and only 14.7% stating in detail the problems of IIoT in their sector ('Problems linked to standards, security and applications of the IIoT in the particular sector'). Consequently, when it comes to the biggest obstacles of SMEs in the implementation of IIoT, the vast majority of the respondents (85.3%) stated that the biggest obstacle is the lack of information and the need of education and training, with 11.8% stating that this obstacle is the lack of funding.

When it comes to the sectors where the IIoT would be more important, the participants claimed all four sectors to be in need of the IIoT. The majority (82.4%) stated that the IIoT would be equally important in Manufacturing and Science, Technology & Education, while 73.5% chose Health Care and 50% Transportation & Logistics (see Figure 31).

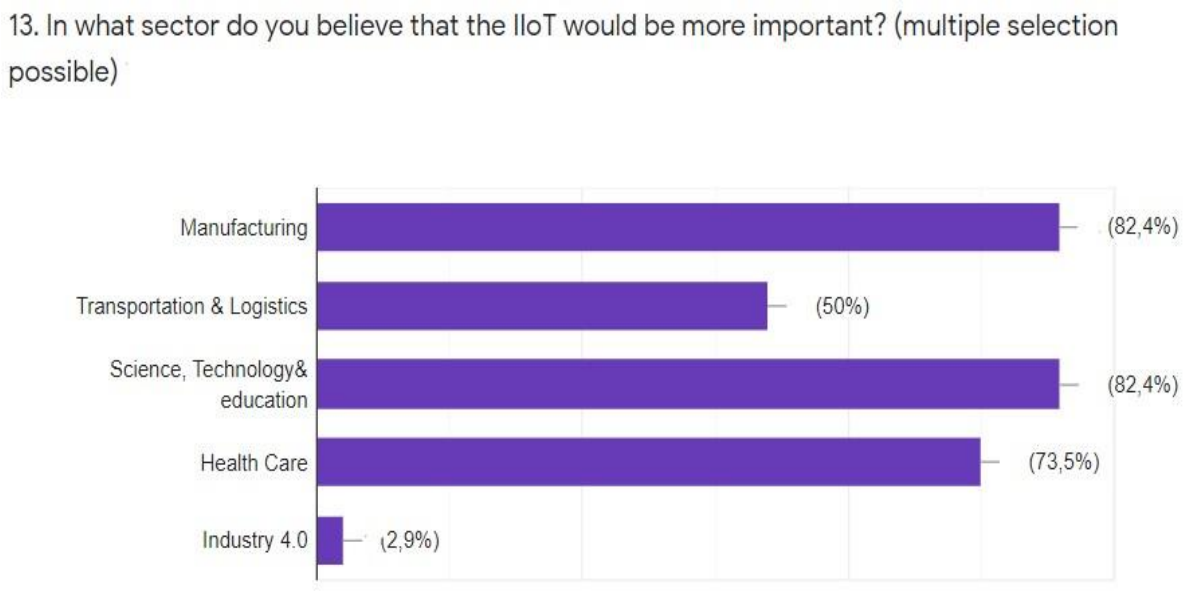


Figure 31

For the introduction and the implementation of IIoT in the companies, the majority of the respondents (73.5%) answered that the needed strategy is education and training, with only 14.7% stating that the companies need exchange of experience with enterprises that already implement it and 8.8% claimed unaware of what strategy is needed for the introduction and implementation of IIoT. Furthermore, according to the majority of the participants, the most adequate team to formulate the objectives of IIoT is the IT department, the digital officer together with the management (47.1%). 32.4% of the respondents stated that the formulation should be done by the management and 17.6% were unaware of which is the most adequate team to handle the matter. The vast majority of the participants (79.4%) also stated that the best structure for an enterprise for the creation and management of the IIoT is the analysis and mapping of the objectives to the available technologies and budget, and the monitoring of the priorities.

The participants stated that there is no clear national policy about the Industry 4.0 in Cyprus (79.4%), with 20.6% stating that they are not aware if such policy exists. On the same matter, 52.9% of the participants stated that there aren't any national IIoT policies in the country, with 38.2% claiming unaware if such IIoT policy exists. On the implementation strategies 94.1% of the respondents stated that the implementation should happen through education and training, 76.5% - through experts' opinion and by using national strategies and good practices, and 70.6% - through the investment in modern technologies.

The majority of the participants claimed unaware of any IIoT providers in the country, with only an 8.8% stating that they have heard of some enterprises. Additionally, the vast majority of the participants (88.2%) reported that they need full training and courses on all issues related to IIoT. In Cyprus, according to almost half of the respondents (58.8%), the main competences of the companies in Cyprus is the implementation and facilitation. Other strengths include ICT and teams of professionals (32.4%), management (26.5%), adaptability (20.6%), organization and VET skills (11.8%) and expertise in service (2.9%).

On the other hand, when asked about the main incompetence of the companies in the country, the majority reported training (79.4%) and the knowledge and expertise in IIoT (76.5%) as the main incompetence and, thus, needs with regard to IIoT for a company.

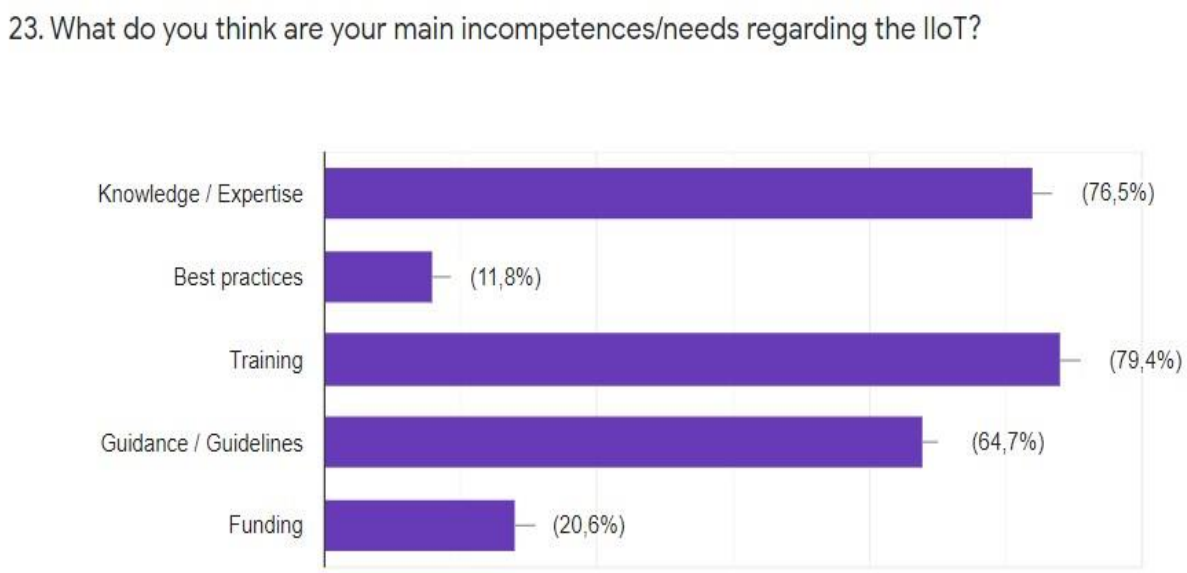


Figure 32

On the questions about the importance of technology in a variety of aspects, the respondents stated that the usage of technology in their job is very important (70 out of106), as well as the IT skills (68 out of 106). When it comes to the capability for the SMEs to deliver trainings to their own personnel, 41 out of 106 of the participants responded that the SMEs are incapable of delivering a training and 29% that they were poorly capable.

On the other hand, the participants reported that large companies are very capable (42 out of 106) or enough capable (32 out of 106) of delivering a training to their own personnel. Additionally, the respondents stated that the VET providers in Cyprus are not at all capable (51 out of 106) or are poorly capable (42 out of 106) of delivering a complete IIoT training. On the same note, a 75 out of 106 of the participants claimed that there aren't any IIoT VET courses taking place in their sector, and that SMEs are not very open regarding an IIoT training (50 out of 106), with only a few stating that the SMEs are quite open in such possibility (17 out of 106).

In contrast, the respondents reported that large companies in the country are more (20 out of 106) or quite (41 out of 106) open to an IIoT training. Similarly, more than half of the participants stated that the corporate sector in Cyprus is poorly informed and aware of the IIoT (52 out of 106). Almost all participants (83 out of 106) stated clearly that the continuous training and learning of an employee is very important. Lastly, the participants stated that the external consulting on IIoT is very important for the SMEs (75 out of 106), as well as for the large companies (53 out of 106).

When it comes to the IIoT training, most participants (73.5%) stated that e-learning in combination with a face-to-face training is the most efficient, with only 20.6% stating that e-learning by itself is enough for an efficient training. The vast majority of the respondents (91.2%) stated that there are not any initiatives on behalf of their enterprise on IIoT/IoT, with only 8.8% stating that they have such initiatives. According to the respondents, such initiatives do not exist at national level (79.4%). When asked about the training needs of the enterprises, most of the respondents reported that a full, all- inclusive training is needed (85.3%), with only 11.8% stating that they need basic, short training. Other responders' answers included an awareness training, handling IIoT challenges and implementation, a training focused on each company's sector etc.

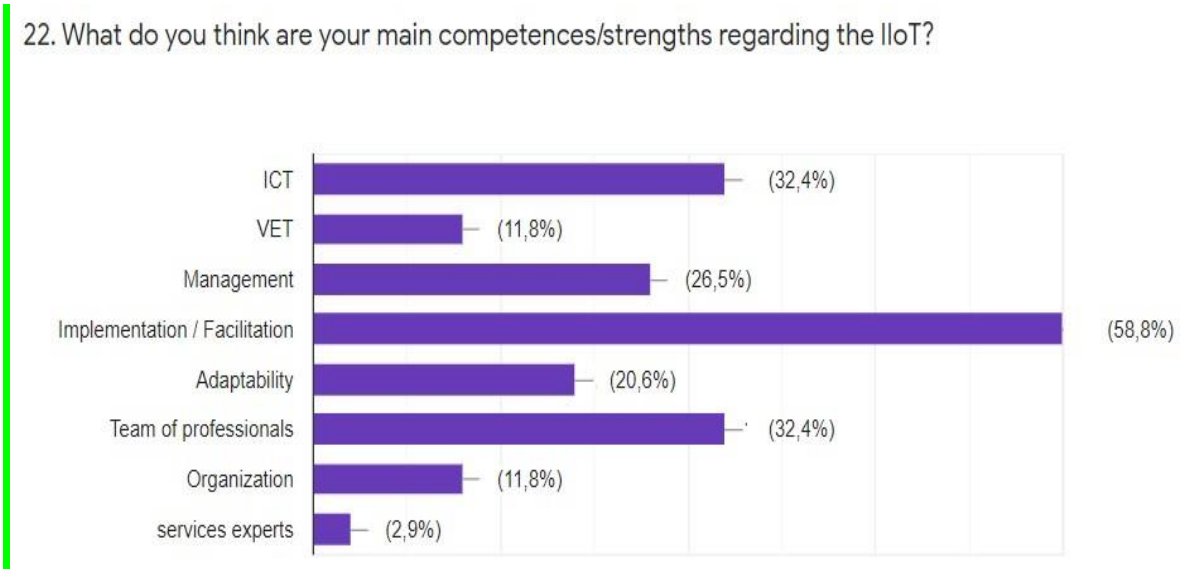


Figure 33

Regarding the type of certification of an IIoT training, 44.1% of the participants responded that a certificate of achieved results should be provided, while 35.3% of the respondents reported that a simple certificate of attendance should be enough. Only 11.8% reported that there should be provided a certificate with a recommendation for work (be appointed) in an IIoT company form a particular industry, and 8.8% reported that the best certificate should be a certificate with recommendation/granted rights to continue with additional VET training.

When it comes to the usage of IIoT products, 67.5% of the participants reported that they do not use such products in their enterprise and only 23.5% reported that they do. The majority of the

participants stated that the most related industry to their knowledge or interest on IIoT products is Science, Technology & Education (64.6%) with only 23.5% stating manufacturing as their most related industry. Other related industries included health care, transport and services.

When asked for the IIoT in their sector, there is a need to specify in more detail the types of used sensors (IIoT devices), the majority responded that they do not have knowledge on this, with only 20.6% stating that there is such a need. Regarding the need to create regular e-notes, distributed to the member of IIoT via subscription network, most of the responders reported that there is a need for this (58.8%), while 26.5% stated that there is not such a need, and 14.7% answered that they did not know if there is such need. These notes should be distributed annually according to the majority of the participants (60%), with a 20% choosing the answer 'monthly' and a 10% choosing the answer 'half-yearly' and 'quarterly'. According to the respondent, if regular distribution of e-notes is provided, the responsible team responsible for the creation and the distribution should be a designated person within the elected management board of IIoTNet (60.7%), while 39.3% stated that the responsible should be a designated person at the industry level of the IIoTNet.

With regard to the creation of the IIoTNet in Europe, the answers were split between the opinion that the IIoTNet in Europe should be created at the technology pillow level of the IIoT (44.1%), and the opinion that the network should be created at the EU level (41.2%), with only a small minority stating that the creation should happen at the level of the participating countries to this project at the initial stage (14.7%).

To support the IIoTNet, the project will use a dedicated private Social Network. When the participants were asked what kind of functions of this Social Network do they envisage to be the most important to facilitate the IIoTNet, the vast majority answered that functions should include the creation of groups per IIoT industry (94.1%), with 47.1% opining that there is a need for the creation of level of management for each group of interest.

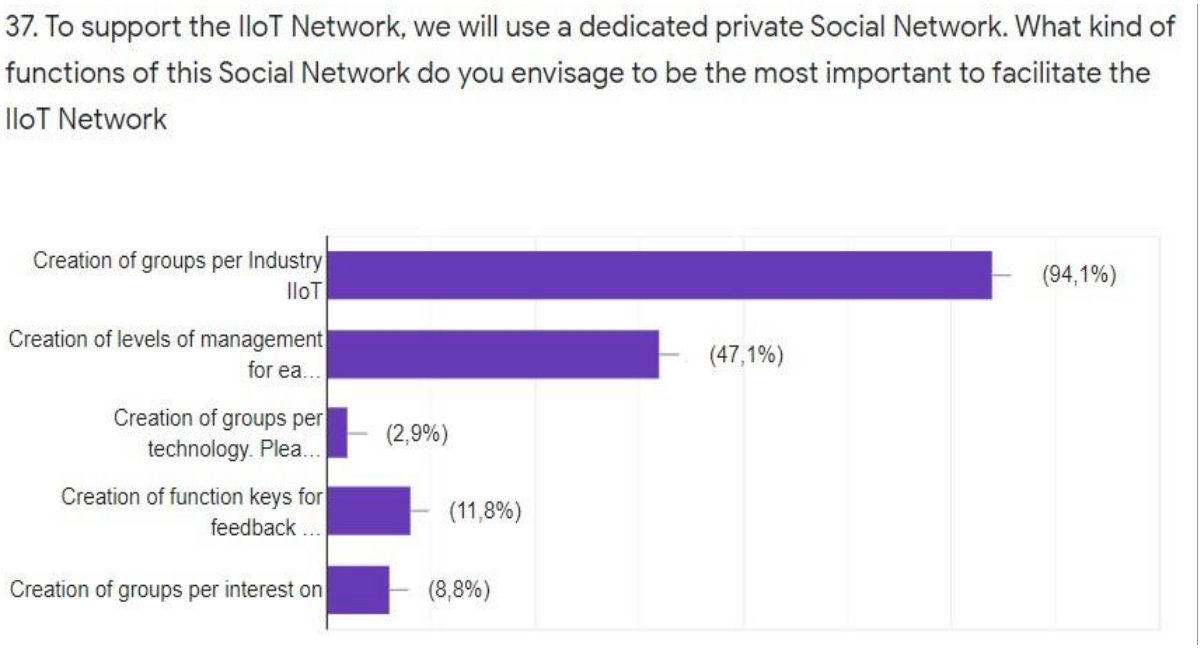


Figure 34

Regarding IIoTNet meetings, most respondents answered that the best way is through e-meeting tools (82.4%), with only 17.6% stating that there is a need to meet physically in a specific country town at least once per year. 73.5% reported that the do envisage to have promotion of products or services related to IIoT members on the website for free, with link to the provider's website – requiring small payment to a person supporting this dynamic functioning of the website (73.5%). The rest of the respondents answered that they do not know (14.7%) and 11.8% reported they do not envisage such service.

When asked about the envisaged establishments of core functions of the IIoTNet, the vast majority (91.2%) of the participants stated that the functions should include a link between IIoT providers.

40. Please select the core functions of the IIoT Network that we envisage to establish (multiple selection possible):

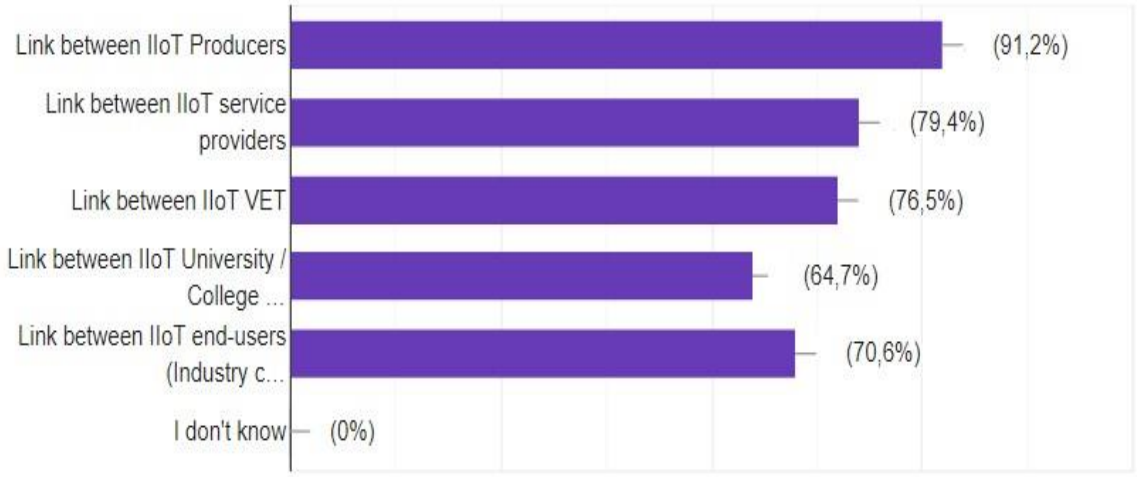


Figure 35

When asked how the Big Data environment (e.g. Hadoop systems) can support the IIoT, half of the respondents opined that this should be done on a large scale for a full IIoT data analysis (47.1%), while 26.5% stated that they do not plan to use Hadoop system for the repository of IIoT data.

41. How can the Big Data environment (e.g. Hadoop systems) support the IIoT

Figure 36

In terms of data, the vast majority of the respondents claimed that manufacturing (82.4%) will be the industry generating the biggest amount of data, with just 8.8% choosing health care, and even less choosing transport and science, technology & education. On the other hand, according to the participants, science, technology & education (70.6%) will be the industry that will generate new

data with the biggest frequency, less the manufacturing (20.6%) and even less transport and health care.

When it comes to the type of network that the respondents expect to use for transferring the data from IIoT devices, more than half of the respondents (55.9%), reported that an Industrial Wi-Fi should be efficient, 26.5% claimed unaware of the type of network, and 14.7 % reported LoRa network

Finally, almost half of the participants stated that they expect a special ICT architecture to collect the data from their IIoT (44.1%), with 38.2% stating they do not such service and 17.6% stating that they do not know. Almost a half reported that they expect to use a special methodology for collection of data from IIoT devices (47.1%), while 35.3% stated that they do not expect such methodology and 17.6% did not have an opinion. Lastly, almost half of the respondents answered that they do not know if they see a role of Industry 4.0 in the creation of IIoTNet, while 32.4% stated that they do not see such role and 23.5% stated that they do.

Conclusion

Cyprus is currently among the last countries in terms of digital maturity. The IIOT is essential to be introduced in all the important sectors of the country, including manufacturing, science, technology & education and health care with effective introduction and implementation strategies based on all-inclusive IIOT education and training.

With the adequate effort put in effective IIoT education training, Cyprus can succeed in unleashing the potential of the IIoT. The small size of the country is not a hindrance. On the contrary, it can be used as a competitive advantage, as it provides easy and fast dissemination of information and a seamless transfer of purpose and overall vision.

3.2.5. ITALY

In Italy, the online survey was filled out by 116 persons belonging to the following target groups, as illustrated in the graph below:

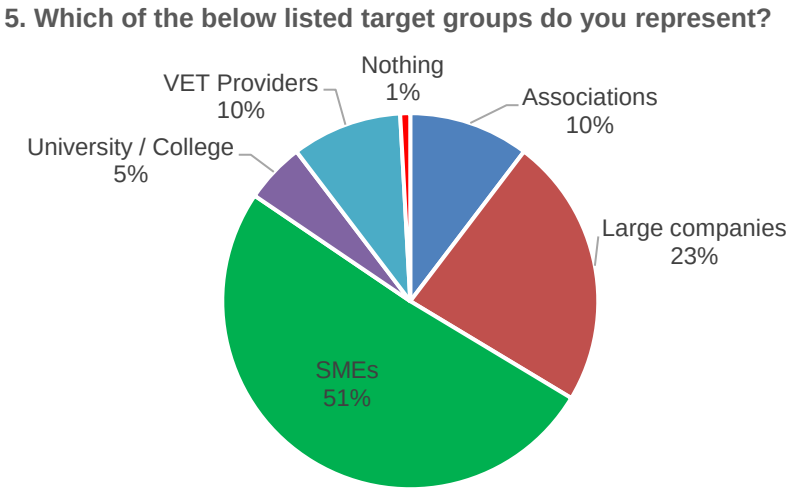


Figure 37

Almost half of respondents (44%) belong to manufacturing companies, while 27% deal with science, technology & education, 21% are working on the transportation and logistics field and the remaining participants belong to the Health Care and Education sector.

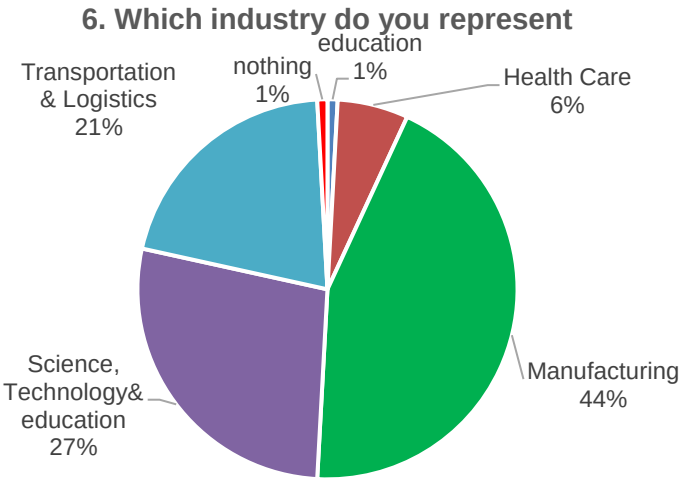


Figure 38

Here, the years of experience in the sector of Industry 4.0 stated by the respondents were equally distributed among 1 to 5 years (29% of the companies), 6 to 10 years (34%) and more than 10 years (34%). Only 3% of the respondents stated having less than 1 year of the experience in the sector.

Half of respondents (56%) own an IoT product, while 32% of them do not own any. 12% stated they do not know.

Those who own IoT product, use this technology mainly to Smartwatch, Home monitoring system, Virtual reality headset, Smart thermostat and refrigerator (52%), Smartwatch and Personal fitness tracker (19%), Personal fitness tracker and pet tracker (24%). The majority of respondents (68%) claim they use an app to manage their IoT devices, while 21 % of them do not use any app.

Based on their personal use of technology and Internet, most of the persons who participated in the survey, stated that technology has an important role in their current life especially when they use it in private life (80 out of 116), that they are very active in the social platforms (76 out of 116) claiming that they are dependent from technology for easy communication (83 out of 116). 73 respondents stated that their peers influence the way they utilize the technology and Internet. More than half of the participants (65%) believe that Italy is a technologically-advanced country, even if someone (26%) think that Italy is just a little bit advanced at technological level. 71 respondent claimed that they are enough familiar with Internet of Thing before filling in the survey. From the analysis of the first part of the survey, it is clear that the majority of involved people use and are familiar with IoT at personal level living in a country defined technologically-advanced.

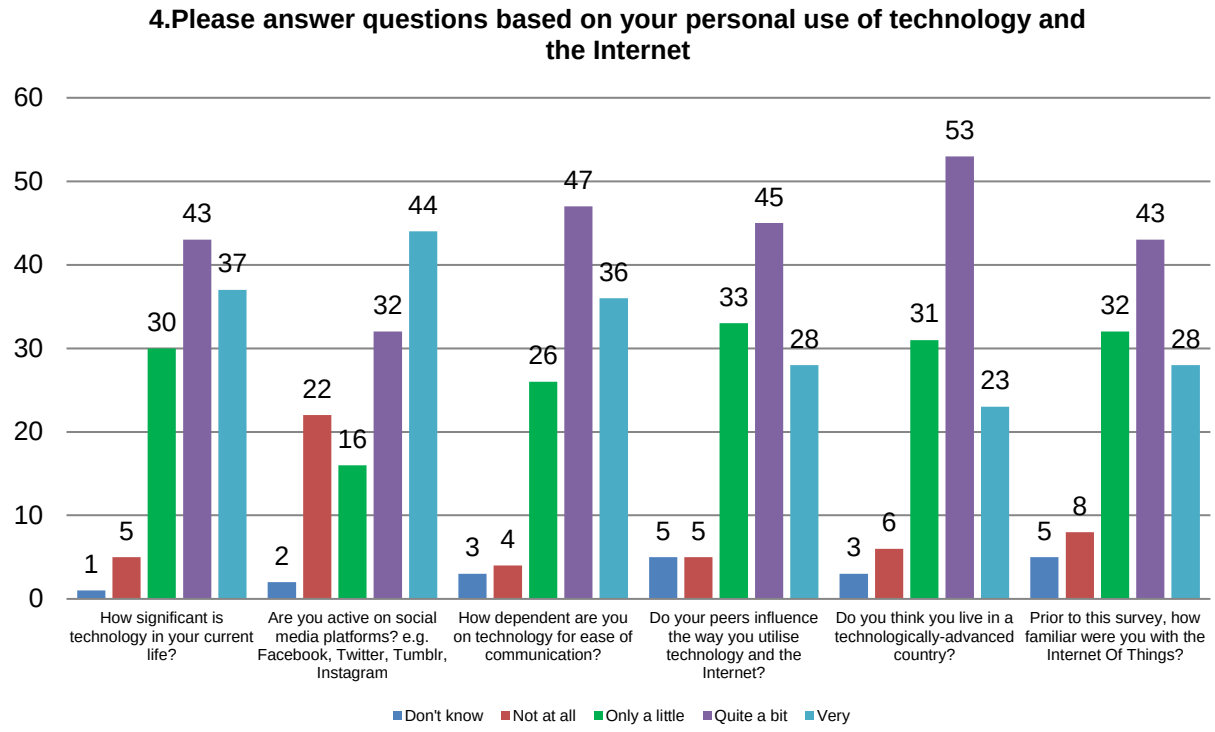


Figure 39

Moving onto the topic on the Industrial Internet of Thing (IIoT), half of the respondents were not able to answer what is the IIoT, while 27% of them thought that it is something to do with Industry and IoT; the remaining 25% answered that it is the application of IoT in Industry, which allows monitoring and control of industrial "things" and processes. Consequently, half of the respondents

did not know what the **benefits** from the use of IIoT are. On the other hand, those who knew of the IIoT, stated that the most significant benefits from the IIoT should be the optimization of industrial processes, improvement of goods production and leading to better quality products and services and to more efficient solutions (26%) and that it might help somehow in some industry applications (26%).

As the idea of the Industrial Internet of Things (IIoT) is not well known among the interviewees, more than half of them were unable to answer the question about if and how the IIoT would help them and/or their enterprise improve their service, while 28% of the remaining respondents answered positively and 14% that IIoT cannot improve enterprise services.

The respondents who know of the IIoT, opined that the main **problems** of IIoT are linked to standards, security and applications of IIoT in the particular sector (26%), while 22% believed there might be problems with the application of IoT in the Industry. The remaining respondents were not able to identify any possible problems.

With reference to the implementation of IIoT in the SMEs, the biggest **obstacles** *(question n.12)* identified by the survey participants are the following:

- Lack of funding (41%)
- Lack of information, such as need education, training, etc. (34%)
- Lack of interest on the part of management (24%)

As seen in the table below, the **main sectors** where IIoT would be more important are manufacturing (51.5%), Transportation & Logistics (22.7%) and Science, Technology & Education (18.4%).

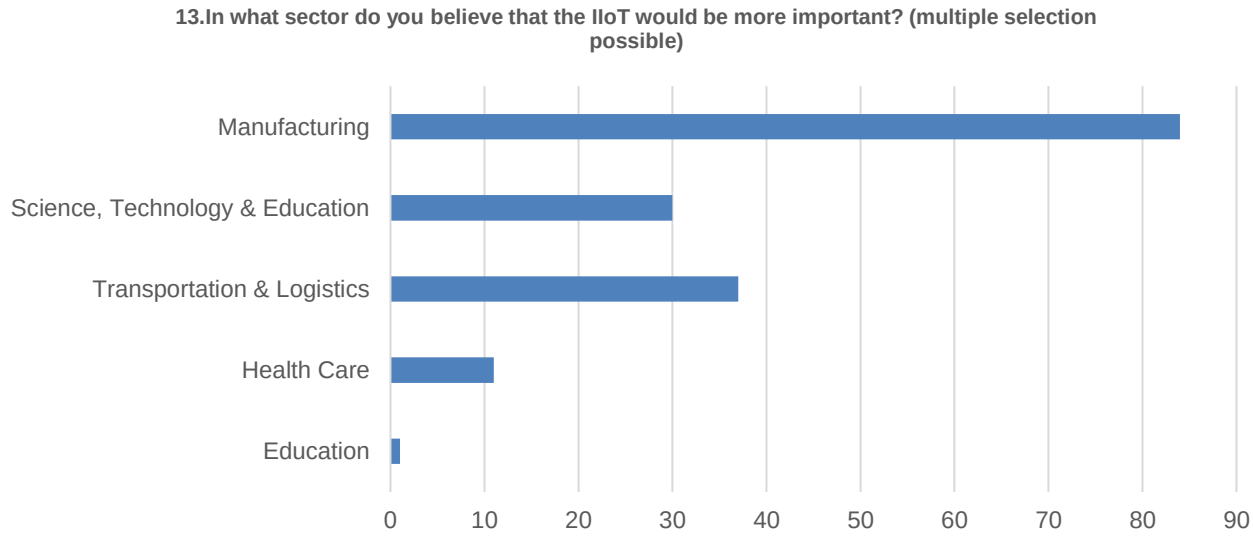


Figure 40

Regarding the necessary strategy for the introduction and implementation of IIoT, the participants' answers are distributed among the education and training needs in an enterprise (19%), exchange of experience with enterprises that already implement it (19%) and need a digital officer and department to implement IIoT (17%). The remaining respondents stated that they do not know what strategy is needed for the implementation of IIoT in companies.

Almost a half of the respondents (46.5%) believed that the management should be responsible for the planning and implementation of the IIoT objectives; also the IT department, and digital officer should cooperate together with the management in the definition of the IIoT objectives (28.5%). The rest of the participants were not able to identify who should formulate the objectives. In this regard, the structure suggested by 39% of the participants should analyse the objectives, map them to the available technologies and the budget and follow the priorities, while 20% of participants believe it should look at other organizations and copy their structure. The other participants stated they do not know what kind of a structure is needed for the creation and management of IIoT.

In Italy, more than half of respondents (66%) stated that there is no clear national policy about the Industry 4.0; only 6% of respondents answered this question positively. The remaining persons did not know. On the same matter, the vast majority of the participants were unaware of there are national IIoT policies in their country.

As shown in the table below, half of the respondents did not know how the IIoT can be implemented in the SMEs; 26% thought that this can be achieved mainly through education and training addressed to the staff company, or taking into account expert opinion, using national strategies and good practices (24%).

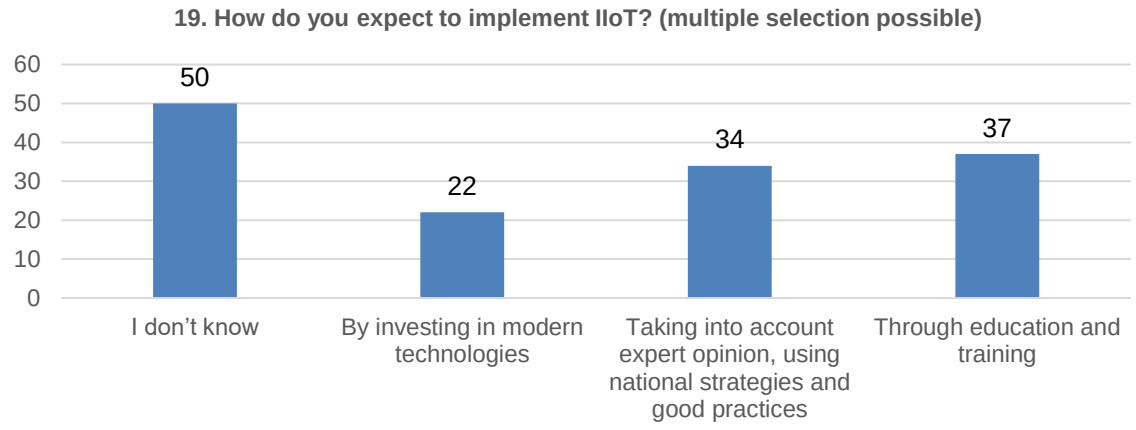


Figure 41

Most of the respondents stated they do not know how many IIoT providers exist in Italy, with only 14.5% having heard of some enterprises that provide IIoT technologies. That's why more than half of participants (65.5%) stated the need to have some courses and training on some issues of IIoT in order to be able to introduce and implement IIoT in their company, and 28% of the respondents – signified a very high need to have full training on all issues related to IIoT.

The vast majority of the respondents stated they do not have specific competences or strengths regarding the IIoT; only some respondents recognised to have ICT competences. On the other hand, they were not able to identify what specific competences they may need for implement IIoT.

The majority of the respondents stated that the usage of technology in their job is important (89 out of 116) as well as the use of IT skills in the job (95 out of 116). Regarding the ability of the Italian companies to train their personnel in IIoT issues, most of respondents thought that both SMEs (92 out of 116) and large companies (91 out of 116) are able to provide the training. They also believed that VET providers can deliver a complete IIoT training to the companies' staff (89 of 116). This result is consistent with the opinion of the majority (98 out of 116) who believe that the continuous training of employees is very important for the introduction and implementation of IIoT in the Italian companies. The IIoT courses in the participants' sectors take place quite often (91 of 116). Both Italian SMEs (88 of 116) and large companies (82 of 116) were open regarding the IIoT training, as well as the corporate sector (90 of 116) were aware about the importance to train companies' staff regarding IIoT issues. The consulting on IIoT topic provided by external professionals are considered relevant both for SMEs (99 of 116) and large companies/associations (94 of 116).

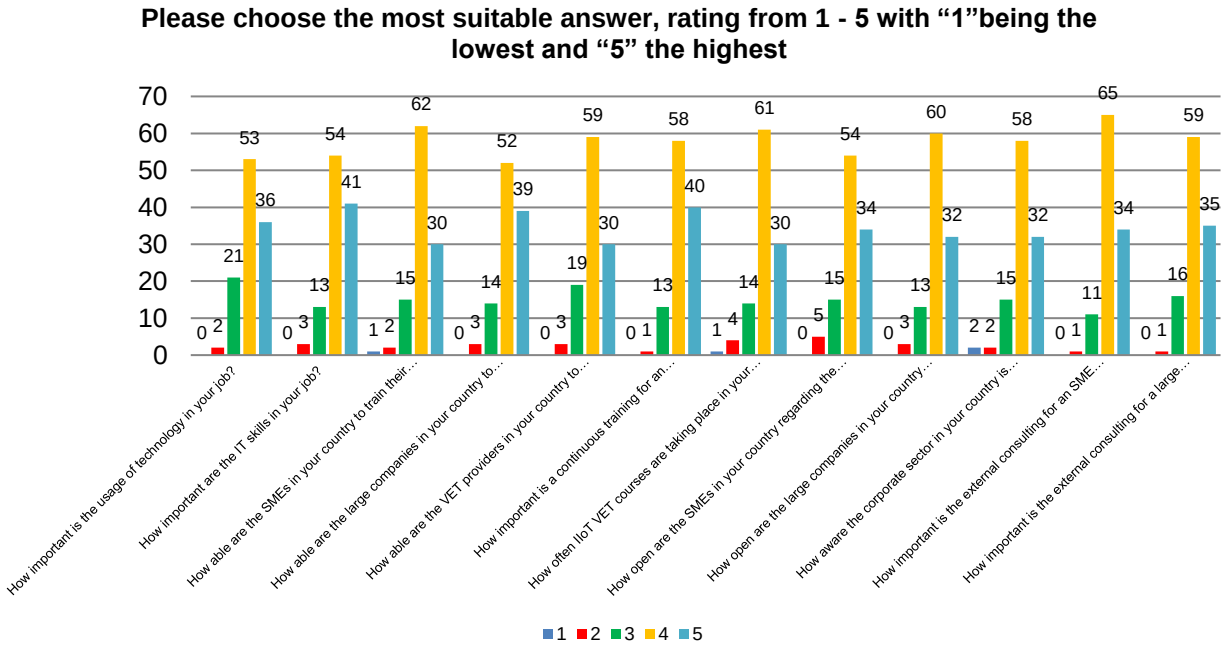


Figure 42

Taking into consideration that the vast majority of participants believe the IIoT training is very important, when we asked them what is the most efficient way of training, half of them answered both e-Learning and Face-to-face, while the remaining respondents preferred only e-Learning (41%) or only face-to-face way (11%).

Most of participants did not know if there are any training initiatives on behalf of their company regarding IoT or IIoT or if there are initiatives at national level. However, the respondents answered that the most efficient training could be courses, webinar, training led by experts including practical activities in order to be able to implement IIoT in the own company. After having completed the training regarding IIoT topics, participants stated that the following certification should be provided:

- Certificate of attendance (33%)
- Certificate with achieved results (39%)
- Certificate with recommendation / granted rights to continue with additional VET training (26%)

When it comes to the usage of IIoT products, 70% of the respondents answered that they use them in their job. More than half of the participants stated that the most related industry to their knowledge or interest on IIoT products is manufacturing (60%).

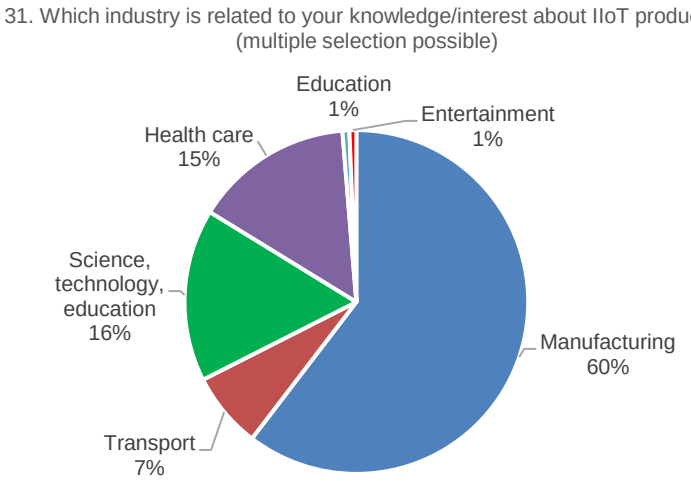


Figure 43

The vast majority of respondents stated that they do not know if there is a need to specify in more details the types of used sensors for IIoT in their industry. However, almost a half of them (48%) believed it needs to create a regular e-notes to be distributed to the members of IIoT via subscription network to be sent monthly (24% of respondents), half-yearly (16%) and quarterly (10%). If regular distribution of e-notes were to be provided, 34.5% of participants stated that a designated person on the elected management board of IIoT Network should be responsible for

the creation and distribution, but also a specific designated person on the Industry level of the IIoT Network (25%). The remaining participants stated they do not know who should be responsible for the e-notes creation.

When it comes to the creation of IIoT Network in Europe, 70% of participants saw the network at European level with only 25% who believed the IIoT Network could be useful only at national level. In this regard, to support IIoT Network, the partnership will use a dedicated private Social Network and participants believed the most important functions should be:

- Creation of groups per Industry IIoT (33%)
- Creation of levels of management for each group of interest (14%)
- Creation of groups per interest on IIoT (10%)
- Creation of levels of management for each group of interest, Creation of function keys for feedback intended for upgrade of the IIoT Network (9%)

With reference to the best way for conducting the meetings of the IIoT Network, 83% of respondents stated that they prefer only e-meeting tools and 17% would prefer to meet physically in a specific country/town at least once per year. 40% of participants agreed to have promotion of products / services related to IIoT members on the Website for free, with a link to the provider's site.

As seen in the figure below, the core functions of the IIoT Network that participants envisaged to establish were the link between IIoT service providers (31.2%) and the link between IIoT producers (26%), with some participants suggesting a link between IIoT end-users and between IIoT University/college educators.

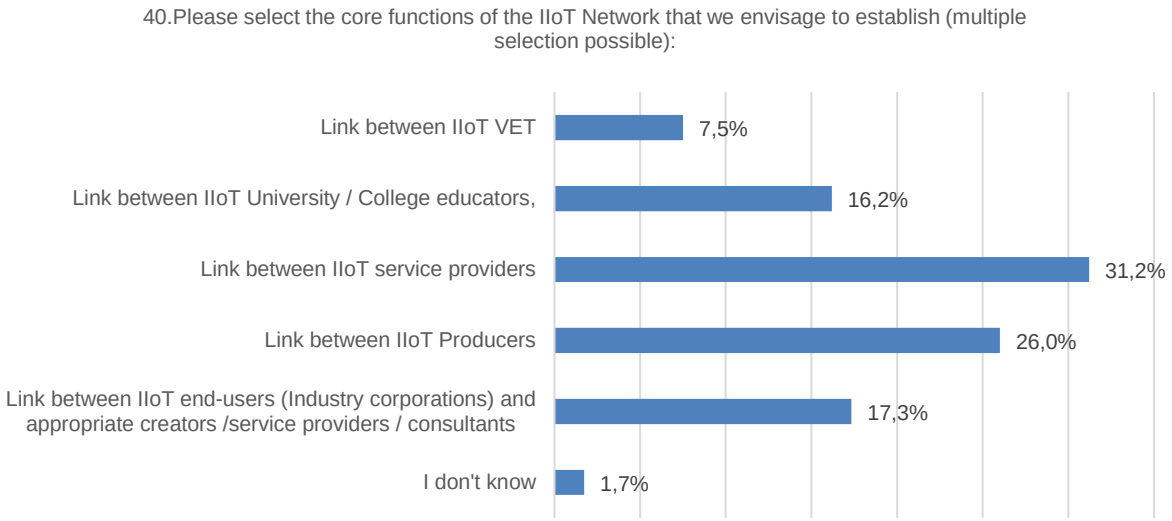


Figure 44

When it comes to the possibility that Big Data environment can support the IIoT, 31% of the respondents stated that it can be useful on a large scale for a full data analysis of IIoT data, 27% of them believed the main IIoT data will be stored there and 25%—that only some data will be stored. From the main four focused Industries, 53% of participants believed that the manufacturing industry will generate the biggest amount of data, followed by the Science, technology, education (18%), Health care (17%) and Transport (8%). The opinion of participants about the industry which will generate new data with biggest frequency is manufacturing (67%) as expected, followed by Health Care (16.4%) and Science, technology, education (13%).

Regarding the type of network participants expected to use for transferring the data from IIoT devices, the most preferred is 5G (52.6%) but also Industrial WiFi (33.6%). The vast majority of the respondents did not expect a special ICT architecture to collect the data from their IIoT or to use a special methodology for collection of data from IIoT devices. Most of participants did not see any role of Industry 4.0 in the creation of IIoT Network.

3.2.6. LATVIA

Following the compilation and analysis of the results, it was concluded that mainly universities and colleges participated in the survey (Table 8).

Table 8

Question 5 – "*Which of the below listed target groups do you represent?*"

Target groups	Respondents answers in LV	Respondents answers in EN	Total	Percentage
Large companies	20	8	28	23.14
Associations	6	1	7	5.79
SMEs	5	2	7	5.79
VET Providers	29	4	33	27.27
University/College	16	16	32	26.44
Other	4	10	14	11.57
Total	**80**	**41**	**121**	**100**

The respondents represented mainly science and technology industry (question 6).

Which industry do you represent?

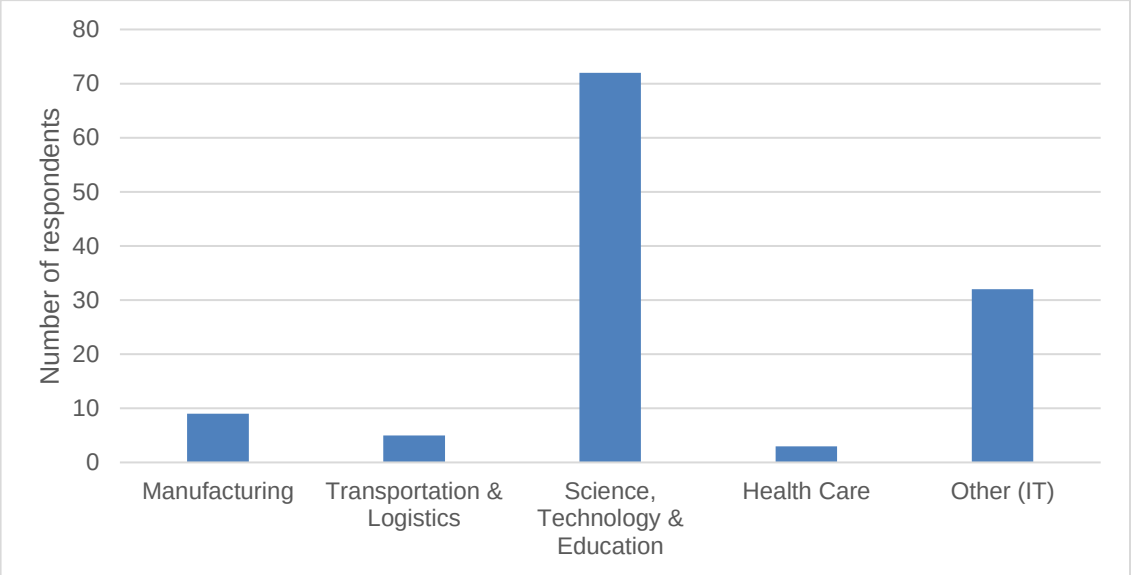


Figure 45

With regard to the years of experience in the industry, the respondents' answers varied; less than 1 year31 respondent, 1-5 years—46, 6-10 years—12 and 10+years—32 respondents.

54%) of the respondents said they own and IoT product, while 30% did not own any; 16% were not sure about the concept, so replied "do not know".

With regard to the IoT products used, the majority replied that they own smart technology, with the second largest group being the one that does not use any IoT technologies (Figure 46)

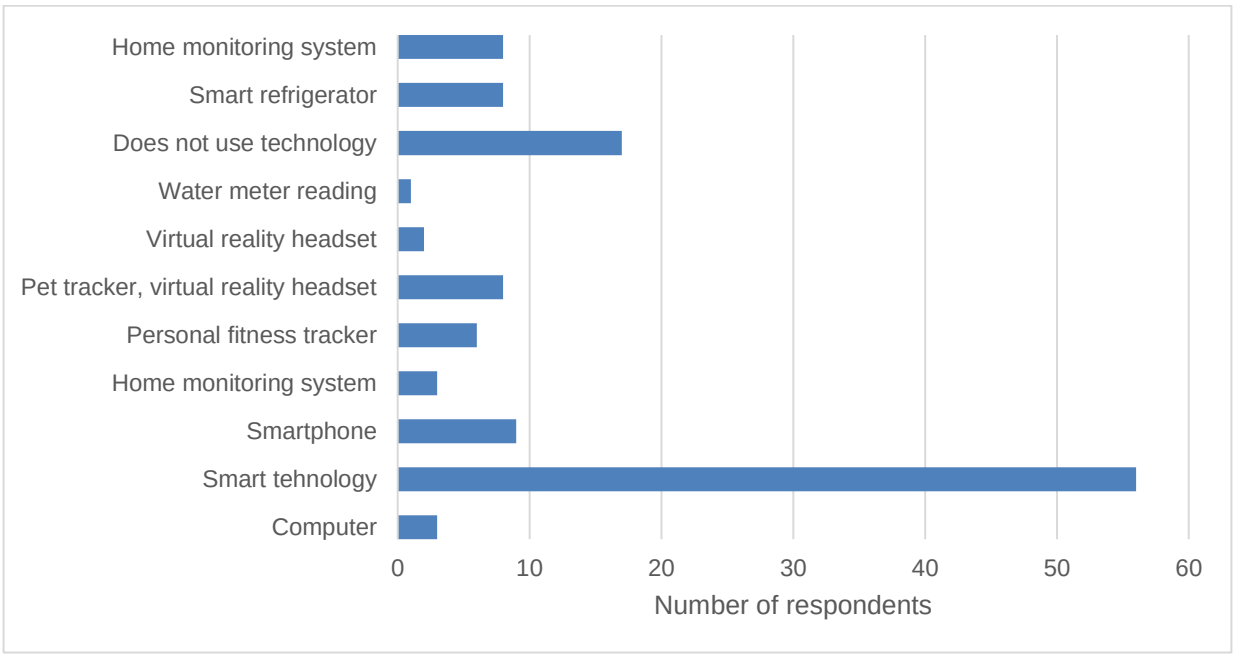


Figure 46

Entrepreneurs can be divided into two categories. First category was informed about the IIoT, with 71 respondents confirming their knowledge of it, and 50 respondents claiming ignorance of the issue. With regard to the possible benefits of the use of IIoT, 67 respondents opined that the main advantage would be in its use and increasing the turnover of the company, whereas 54 respondents claimed that they have no knowledge of the possible benefits from IIoT.

Survey results show that the Internet of Industrial Affairs would help companies improve their services.

Do you think the IIoT would help you and/or your enterprise improve your service?

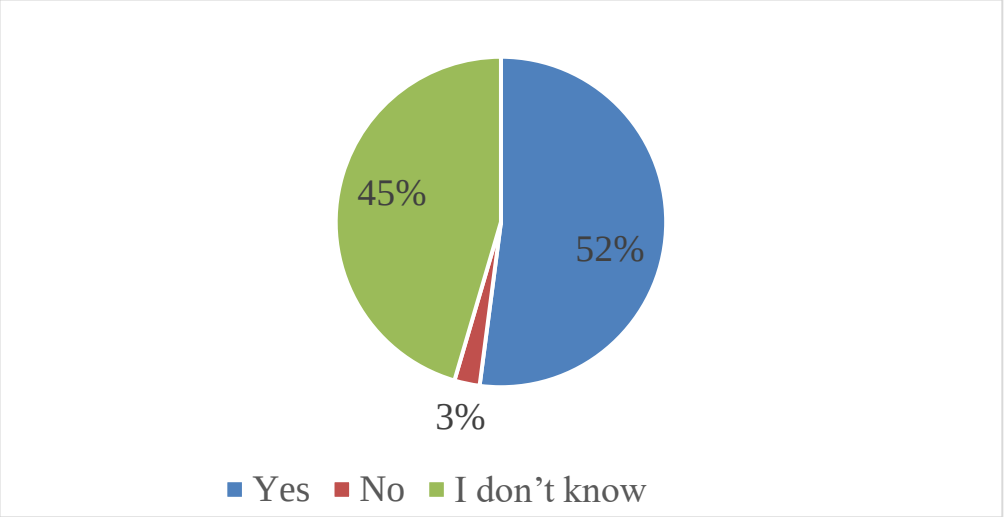


Figure 47

According to the survey, it can be concluded that companies would willingly introduce the Internet of Industrial Affairs through education and training, but also through taking into account expert opinion, using national strategies and good practices (45.5%), but they would not be willing to invest in modern technologies (6.61%).

The 3rd part of the survey began with questions about usage of IT in respondents' job, available training regarding and the importance of an external consultant regarding IIoT; respondents had to rank their answers from 1 to 5 with "1" being the lowest and "5"—the highest. As seen in Figure 48, most of the respondents agree that the use of technology and IT skills in their job are very important (more than 50% of respondents rate it "5"). The respondents stated that SMEs and large companies is not really able to train their own personnel and there is not enough IIoT VET courses in represented sector.

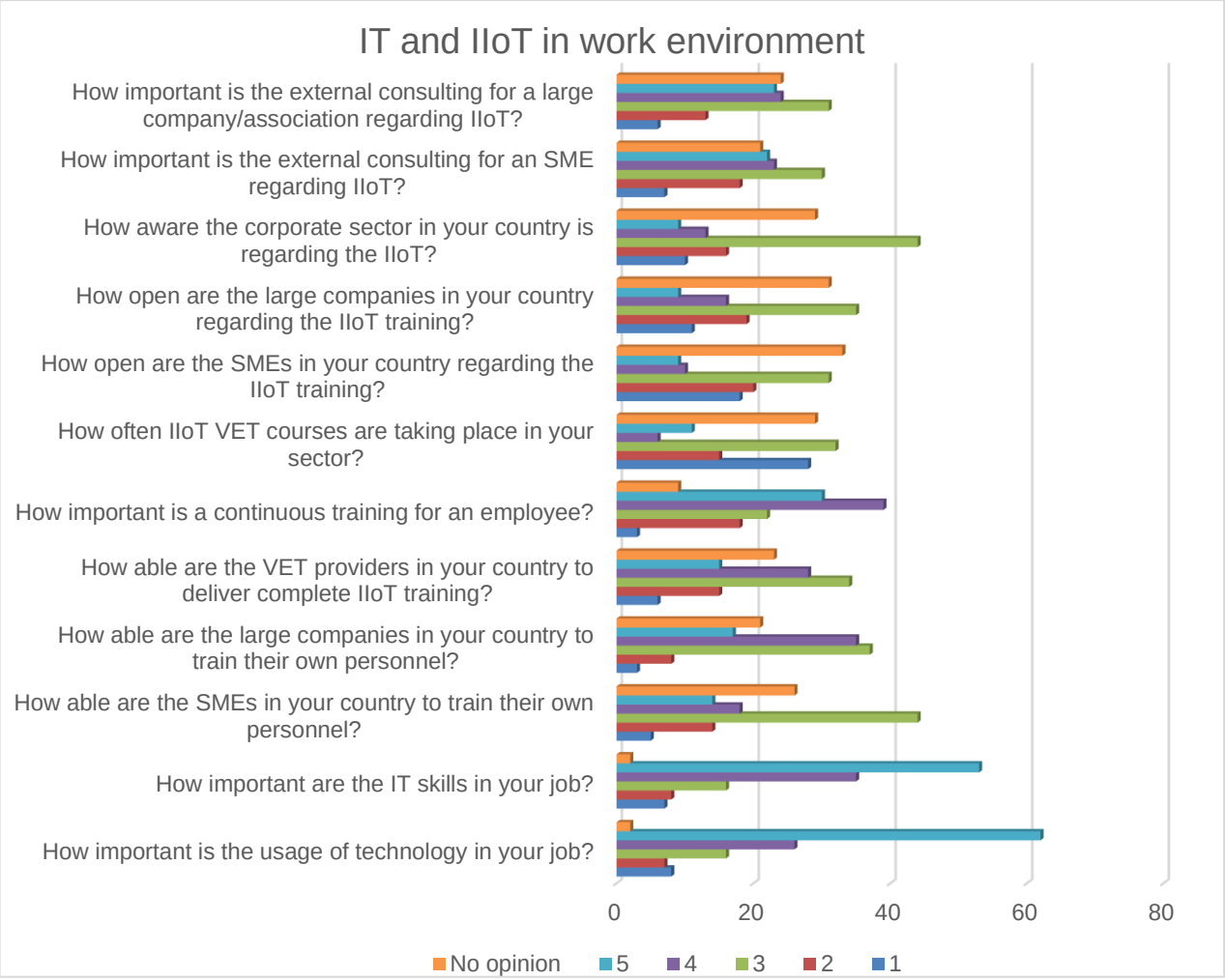


Figure 48

Responding to Part 4 of the questionnaire, 31.4% of the respondents answered that it would be necessary to create regular e-notes distributed by IIoT members on the subscription network, while 20.7% said that they do not know. It could be explained as a lack of the respondents' awareness in IIoT. From the group of the respondents who answered that regular e-notes should be created or have doubts about their necessity, 19.8% thought that e-notes should be distributed monthly, 14.9% thought that e-notes should be distributed quarterly, 9.1% - that e-notes should be distributed half-yearly, and 18.3% - annually.

The companies surveyed in Latvia believe that the establishment of the Internet of Things should be ensured at EU level (25.6%). 14.1% of the respondents believe that it should initially be implemented at the level of the participating countries (Latvia, Sweden, Cyprus, Greece, Bulgaria, Italy).

If there were a private social IIoT, most of the respondents would admit that the most important function would be in each IIoTNET industry.

The number of innovative companies is increasing in Latvia; in recent years, the total amount of research and development investment in Latvia has increased, as well as the proportion of innovative companies, which at the moment is just over 30% of all companies. The substantial raise in the awareness of the digitalization of companies is a basis for increasing their productivity and competitiveness. Several state aids are available for the development of innovation. Latvia is now at the beginning of an ambitious road map to the development of Industry 4.0 yet the development of the IT industry is severely hampered by a lack of specialists.

Conclusion

Firstly, this report contains an analysis of the impact of digitalization on the labour market in those economies experiencing the digital revolution. Secondly, the current state of implementation of the IIoT in the six partner countries was briefly discussed. Finally, the surveys carried out in the six partner countries were looked at, with the aim of grasping the situation on training needs in the six countries. The results of the survey are expected to serve as a reflection on how the digital revolution can transform the labour market and people can be supported in order to enhance their employability. Conversely, an analysis of jobs that are expected to be in demand in the near future – new occupations will appear and some will slowly disappear as they become automated – will encourage people (particularly the existing and the prospective students) to better prepare themselves for their professional careers and give them a clearer perspective about the labour market they will work in, upon completion of their education.

The conclusions that can be drawn from the report are as follows:

- Increasing the supply of specific skilled labour will be crucial in the future. Efforts are needed to attract labour to the job. These would include implementing improved working conditions at workplaces to retain and attract new workforce within the operations. In all six partner countries, IIoT will become a key factor to attract competence or to get competence from a provider on a distance-based layout.

- Humanity has set itself up for a new technological revolution borders; they will radically change the way we live and work and treat each other. Major changes will occur in all sectors and in all professions. Overall, digitization is a huge challenge for education, science and industry.
- In order to ensure GDP growth economic policy makers need to look for new solutions to raise the level of economic activity, paying particular attention to pre-retirement age people, as well as creating additional incentives for retiring people and retirement age.
- The six partner countries (with a possible exception of Sweden) are still in a phase of development in the use of digital technologies. While a large part of the population uses the Internet for personal use on a daily basis, especially SMEs are lagging behind in adapting to the digitisation of processes, not using a full digital growth strategy. The lack of digital skills by the workers, both managers and employees, is an obstacle to the digitisation of companies, especially SMEs.
- Digital literacy is, in fact, one of the crucial points on which to intervene, reprogramming training, in all orders and grades and ensuring the acquisition, by VET providers, of the knowledge and skills needed to accompany society on the difficult path towards digitization.
- It is difficult to predict precise development, but today it is obvious that Industry 4.0 will affect all groups, layers and people interlayer; almost all professions. Industry 4.0 is

characterized by technology convergence and boundaries disappearance between the physical, digital and biological realms. The process of education has to start from the nursery and must continue as a life-long learning, integrating into mainstream education, vocational training, and in college.

- Despite all the challenges presented, the new technologies provide also important opportunities of increasing quality employment, of improving the safety of production processes, of stimulating start-ups and fostering youth employment. Digitalisation can transform existing jobs, demanding new skills to carry out new tasks, which may imply that the current work force has to be retrained or replaced by workers who already have these skills. However, digitalisation and automation impact on the quality and conditions of work, modifying the structure and the composition of the workforce by increasing the demand for highly specialized jobs.
- In order to increase the matching between supply and demand and to promote the competitiveness of the workforce, IIoT training schemes should be planned and implemented for the regular upgrading and retraining of the workforce associated with the use of new technologies and promote the need for lifelong learning.
- From the online surveys analysis, the majority of involved people use and are familiar with IoT at personal level. With reference to the implementation of IIoT in the SMEs, the biggest obstacles identified by the survey participants are related to the lack of funding, lack of information, lack of education, training, etc., and lack of interest on the part of management.
- The risks associated with the IIoT and digitalization of the employment scene come in addition to a series of crucial challenges that the European economy and world of work are confronted with, such as the ageing of the population, the need to reduce gender disparity in the labour market, territorial imbalances and the necessity to ensure the sustainable internationalization of economic relations.
- All relevant policy makers should pay a close attention to IIoT when developing their respective vocational education systems and programmes both at secondary and higher level, ensuring investments in infrastructure, content development, increasing the importance of vocational education, as well as greater involvement of employers.
- For this reason, the majority of participants stated the necessity to attend courses and training on IIoT issues in order to be able to introduce and implement IIoT in their company. The role of VET providers in this context is relevant, by delivering a complete IIoT training to the staff. This result is consistent with the opinion of the majority who believe that the continuous training of employees is essential for the introduction and implementation of IIoT in companies.
- All countries should introduce national IIoT (Industry 4.0) policies; they should also guide the various sectors to analyse the objectives, map them to the available technologies and the budget and follow the priorities as to create and manage a successful IIoT in each enterprise. The introduction and implementation of the IIoT should be developed through

adequate education and training of the personnel, as well as with a variety of tools, such as IIoT devices, creation of e-notes, the development of a social network, e-meetings, Hadoop systems, industrial Wi-Fi, special ITC architecture and special technology for IIoT data collection, and promotion of services and products online.

Abbreviations used

Abbrevation	Explanation
IoT	Internet of things
IIoT	Industrial Internet of things
M2M	Machine to machine
OT	Operation technologies
IT	Information technologies
EU	European Union
IIoTVETNet	Industrial internet of things Vocational education and training network
SMEs	Small and medium-sized enterprises
VET	Vocational Education and Training
Industry 4.0	fourth industrial revolution
ITPIO	Institute for Training of personnel in international organisations
PIB	Vocational education association
TUCEP	Tiber Umbria comet education programme
AKMI	Sectoral network of VET
IPS	Institute for postgraduate studies
ReadLab	Research innovation and development Lab P.C.
DIMITRA	Dimitra Ekpaiditiki Simvilitiki
WG	Working group
ETF	European training foundation
3G	Third generation
4G	The fourth generation of broadband cellular network technology
LTE	Long-Term Evolution
5G	The fifth generation technology
2G	Second-generation

1 Annex

IIoTNET National Survey

The Internet Of Things (IoT) refers to the not far future with wireless inter-connectivity between objects and everyday devices by creating intelligence systems that transfer and exchange data without the need of human-to-human interaction.

The aim of this Survey is to find out the organization situation in relation to Industry 4.0 in particular Industrial IoT (IIoT) technologies and to produce a Transnational report about possible support for SMEs in meeting the demands of Industry 4.0 (IIoT technologies).

1st block

1. Do you own an Internet Of Things (IoT) product?

☐ Yes
☐ No
☐ I don't know

2. Which IoT product(s) do you own. Select all that apply:

☐ Smartwatch
☐ Personal fitness tracker
☐ Smart refrigerator
☐ Smart thermostat
☐ Home monitoring system
☐ Pet tracker
☐ Virtual reality headset
☐ Other (please specify) _____

3. Do you use an app to manage your IoT devices?

☐ Yes
☐ No
☐ I don't know

4. Please answer questions based on your personal use of technology and the Internet

	Very	Quite a bit	Don't know	Only a little	Not at all
How significant is technology in your current life?					

Are you active on social media platforms? e.g. Facebook, Twitter, Tumblr, Instagram					
How dependent are you on technology for ease of communication?					
Do your peers influence the way you utilise technology and the Internet?					
Do you think you live in a technologically-advanced country?					
Prior to this survey, how familiar were you with the Internet Of Things?					

2nd block

5. Which of the below listed target groups do you represent?
   - ☐ Large companies
   - ☐ Associations
   - ☐ SMEs
   - ☐ VET Providers
   - ☐ University / College
   - ☐ Other (please specify) _____

6. Which industry do you represent

   - ☐ Manufacturing
   - ☐ Transportation & Logistics
   - ☐ Science, Technology& education
   - ☐ Health Care
   - ☐ Other (please specify) _____

7. How many years of experience do you have in the sector?
   - ☐ less than 1
   - ☐ 1-5
   - ☐ 6- 10
   - ☐ 10+

8. What do you know of IIoT (Industrial IoT)?
   - ☐ Nothing
   - ☐ It is something to do with Industry and IoT
   - ☐ It is the application of IoT in Industry, which allows monitoring and control of industrial "things" and processes

9. What are the benefits from IIoT?
   - ☐ I don't know
   - ☐ Might help somehow in some industry applications
   - ☐ Can optimize industrial processes, can improve the production of goods and lead to better quality products and services, to more efficient solutions

10. Do you think the IIoT would help you and/or your enterprise improve your service?
    - ☐ Yes
    - ☐ No
    - ☐ I don't know
    - ☐ Other (please specify) _____

11. What are the problems in IIoT?
    - ☐ I don't know
    - ☐ Problems with the application of IoT in the Industry
    - ☐ Problems linked to standards, security and applications of IIoT in the particular sector
    - ☐ There are no problems in IIoT
    - ☐ Other (please specify) _____

12. What are the biggest obstacles for SMEs in the implementation of IIoT?
    - ☐ Lack of funding
    - ☐ Lack of information (need education, training)
    - ☐ Lack of interest on the part of management
    - ☐ There are no obstacles for SMEs in the implementation of IIoT
    - ☐ Other (please specify) _____

13. In what sector do you believe that the IIoT would be more important?
    - ☐ Manufacturing
    - ☐ Transportation & Logistics
    - ☐ Science, Technology& education
    - ☐ Health Care

☐ Other (please specify) _____

14. What strategy is needed for the introduction and implementation of IIoT?

☐ I don't know
☐ Exchange experience with enterprises that already implement it
☐ Need education and training in a enterprise
☐ Need a digital officer and department to implement IIoT
☐ Other (please specify) _____

15. Who should formulate the objectives of IIoT?

☐ I don't know
☐ The management
☐ The IT department, digital officer together with the management
☐ Other (please specify) _____

16. What kind of a structure in the enterprise is needed for the creation and management of IIoT?

☐ I don't know
☐ Have to look at other organizations and copy their structure
☐ Have to analyze the objectives, map them to the available technologies and the budget and follow the priorities
☐ Other (please specify) _____

17. Is there a clear national policy about the Industry 4.0 in your country?

☐ Yes
☐No
☐I don't know

18. Are there national IIoT policies?

☐ I don't know
☐ Heard of a few things in this area
☐ Yes, there are Industry 4.0 initiative and other national policies

19. How do you expect to implement IIoT? *(multiple selection possible)*

☐ I don't know
☐ Through education and training
☐ Taking into account expert opinion, using national strategies and good practices
☐ By investing in modern technologies
☐ Other (please specify) _____

20. How many IIoT providers do you know?
    - ☐ I don't know any
    - ☐ Heard of some enterprises
    - ☐ I know several enterprises and IIoT providers

21. Do you need training and consultancy for the introduction and implementation of IIoT?
    - ☐ No, we know all about it
    - ☐ We need some courses and training on some issues of IIoT
    - ☐ We need full training and courses on all issues related to IIoT

22. What do you think are your main competences/strengths regarding the IIoT?

    _____
    _____
    _____
    _____

23. What do you think are your main incompetences/needs regarding the IIoT?

    _____
    _____
    _____
    _____

3rd block

24. Please choose the most suitable answer, rating from 1 -5 with "1"being the lowest and "5" the highest

	1	2	3	4	5	No opinion
How important is the usage of technology in your job?						
How important are the IT skills in your job?						
How able are the SMEs in your country to train their own personnel?						
How able are the large companies in your country to train their own personnel?						
How able are the VET providers in your country to deliver complete IIoT training?						
How important is a continuous training for an employee?						
How often IIoT VET courses are taking place in your sector?						

How open are the SMEs in your country regarding the IIoT training?						
How open are the large companies in your country regarding the IIoT training?						
How aware the corporate sector in your country is regarding the IIoT?						
How important is the external consulting for an SME regarding IIoT?						
How important is the external consulting for a large company/association regarding IIoT?						

25. What do you believe is the most efficient way of training?

☐ E-learning
☐ Face to face
☐ Both
☐ Other (please specify) _____

26. Are there any training initiatives on behalf of your enterprise regarding IIoT / IoT?

☐ Yes
☐ No
☐ I don't know
☐ Other (please specify) _____

27. Are there any training initiatives on national level in your country regarding IIoT / IoT?

☐ Yes
☐No
☐I don't know
☐ Other (please specify) _____

28. What kind of a training would be the most efficient for you and your enterprise? Please describe potential content and structure:

_____
_____

_____
_____

29. After training about IIoT, what certification should be provided:

☐ Certificate of attendance
☐ Certificate with achieved results
☐ Certificate with recommendation / granted rights to continue with additional VET training
☐ Certificate with a recommendation for work (be appointed) in a IIoT company from a particular industry
☐ Other (please specify) _____

4th block

30. Do you use any IIoT products and/or are aware of the IIoT

☐ YES
☐ NO

If your answer was YES please continue with the next 20 questions:

31. Which industry is related to your knowledge/interest about IIoT products

☐ Manufacturing
☐ Health care
☐ Transport
☐ Science, technology, education
☐ Other (please specify) _____

32. Do you think that for IIoT in your industry, we need to specify in more details the types of used sensors (IIoT devices)

☐ No
☐ Yes (please specify) _____
☐ Other (please specify) _____

33. Do you think we need to create a regular e-notes, distributed to the members of IIoT, via subscription Network

☐ YES
☐ NO
☐ I don't know

34. If YES, how frequent should the distribution be

☐ Monthly
☐ Quarterly
☐ Half-yearly

☐ Annual
☐ Other (please specify) _____

35. If regular distribution of e-notes is provided, who should be responsible for the creation and the distribution:

☐ On the elected management board of IIoT Network – a special designated person
☐ On the Industry level of the IIoT Network – a special designated person
☐ Other (please specify) _____

36. How do you see the creation of IIoT Network in Europe

☐ On the EU level
☐ On the level of the participating countries to this project at the initial stage
☐ Only on a national level
☐ On the technology pillow level of the IIoT
☐ Other (please specify)_____

37. To support the IIoT Network, we will use a dedicated private Social Network. What kind of functions of this Social Network do you envisage to be the most important to facilitate the IIoT Network

☐ Creation of groups per Industry IIoT
☐ Creation of levels of management for each group of interest
☐ Creation of groups per technology. Please specify _____
☐ Creation of function keys for feedback intended for upgrade of the IIoT Network
☐ Creation of groups per interest on
  ☐ EU level
  ☐ National level
  ☐ Industry level
  ☐ Other level – please specify _____
☐ Others (please specify) _____

38. How would you prefer to conduct the meetings of the IIoT Network

☐ Only with e-Meeting tools
☐ At least once per year to meet physically in a specific country/town
☐ Other (please specify) _____

39. Do you envisage to have promotion of products / services related to IIoT members on the Website for free, with link to the provider's site (this will require some small payment to a person supporting this dynamic functioning of the Website)

☐ Yes
☐ No
☐ I don't know

40. Please select the core functions (possible more than 1) of the IIoT Network that we envisage to establish:

☐ Link between IIoT Producers
☐ Link between IIoT service providers
☐ Link between IIoT VET
☐ Link between IIoT University / College educators
☐ Link between IIoT end-users (Industry corporations) and appropriate creators / service providers / consultants
☐ I don't know
☐ Other (please specify)
_____

41. How can the Big Data environment (e.g. Hadoop systems) support the IIoT
☐ On a large scale for a full data analysis of IIoT data
☐ The main IIoT data will be stored there
☐ Only the big files from IIoT will be stored there
☐ Only some data will be stored
☐ We do not plan to use Hadoop system for repository of IIoT data
☐ I don't know

42. From the main 4 focused Industries, which one will generate the biggest amount of data

☐ Manufacturing
☐ Health care
☐ Transport
☐ Science, technology, education
☐ I don't know

43. Which industry will generate new data with biggest frequency

☐ Manufacturing
☐ Health care

☐ Transport
☐ Science, technology, education

44. Which type of network do you expect to use for transferring the data from IIoT devices

☐ LoRa
☐ 4G - GSM
☐ 5G
☐ Industrial WiFi
☐ I don't know
☐ Other (please specify) _____

45. Do you expect a special ICT architecture to collect the data from your IIoT

☐ No
☐ Yes – please specify _____

46. Do you expect to use a special methodology for collection of data from IIoT devices

☐ No
☐ Yes – please specify _____

47. Do you see any role of Industry 4.0 in the creation of IIoT Network

☐ No
☐ Yes – please specify _____

Thank you for your time and contribution!

2 Annex