National Report

Cyprus

Center for Social Innovation

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

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1. Introduction

In Cyprus, we are already on the verge of a new era, the Fourth Industrial Revolution, this coexistence of the digital, physical and biological worlds. This is a change that extends horizontally at all levels and creates new challenges for mankind. The new age is not just digitization, networking, automation, but the breaking of the traditional boundaries between the natural sciences, the biological sciences and information technology and the introduction of new technological breakthroughs such as robotics, technical intelligence, advanced life sciences, nanotechnology, coding money, big data sets, the Internet of Things, and great computing capabilities. All of this is changing exponentially everything: the economy, work, health, education, production and governance systems, the way we deal the personal lives of people[1].

Cyprus is in the group of European countries with low digital performance among the most important sectors. Despite its weaknesses, the country can join the core of countries with high index of digital economy and society, because of its huge reserves of know-how, science and labour. After all, the new smart era of the Fourth Industrial Revolution does not require the infrastructure of previous times, but sufficient funding, trained human resources, design and new type of infrastructure. The goal now is to reach that level of efficient and effective training, design and infrastructure as to introduce and implement an all-inclusive Industrial Internet of Things (IIoT)[2].

2. Cypriot labour market: digital transformation and emerging trends

Cyprus has announced the new holistic and integrated National Industrial Strategy 2017-2030, which is fully aligned with the objective of digitizing European industry, where the various Member States and the Commission work together to find common solutions to make digitization of European industry a reality through shared solutions and learning from each other. Clearly, the country still has a long way to go, as in Europe, only one in five companies is highly digitized, and Cyprus is not one of them[3].

Cyprus is in the process of making its digital innovation hubs operational and reinforcing artificial intelligence in its processes. The country has expressed its support for the new European Artificial Intelligence Strategy by signing the European Declaration on Cooperation in Artificial Intelligence.

[1] Parliament of Cyprus, *Meeting of the Parliament, Fourth Industrial Revolution: Enforced Actions. Conference Proceedings.* Nicosia: Research and Publications Office, 2019. Retrieved from: http://www.parliament.cy/images/media/assetfile/Viomixaniki4%20B.pdf

[2] Industry for Development, *The New Industrial Policy of Cyprus 2019 – 2030 [Action Plan for period 2019 - 2022].* Nicosia: 2019

[3] Parliament of Cyprus, *Meeting of the Parliament, Fourth Industrial Revolution: Enforced Actions. Conference Proceedings.* Nicosia: Research and Publications Office, 2019. Retrieved from: http://www.parliament.cy/images/media/assetfile/Viomixaniki4%20B.pdf

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Efforts are united to foster public and private investment in artificial intelligence and to prepare society as a whole for the socio-economic changes expected, such as employment-related changes, as well as certain parts of the work, which will be done with computers. These are skills that the country lacks and needs to ensure will be effectively offered, that no one is left behind and that all citizens have the necessary digital skills to participate in digital society[4].

The workforce also needs to upgrade and update its skills. In addition, there is a need for more Technology, Information and Communication (ICT) specialists to fill the growing number of vacancies in all sectors of the economy. Cyprus has a national coalition for digital jobs and is a member of the European Coalition for Digital Skills and Jobs, collaborating for these issues together[5].

At this time of the Fourth Industrial Revolution, this blending of the digital, physical and biological worlds, which is constantly and exponentially changing all areas of human life and activity, economy, work, work relations, type of work, education, health, public administration, production and governance systems, the political and economic order of things[6].

In the field of employment, both the nature and conditions of work will be drastically changed, 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[7].

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[8].

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

[4] Parliament of Cyprus, *Meeting of the Parliament, Fourth Industrial Revolution: Enforced Actions. Conference Proceedings.* Nicosia: Research and Publications Office, 2019. Retrieved from: http://www.parliament.cy/images/media/assetfile/Viomixaniki4%20B.pdf

[5] Industry for Development, *The New Industrial Policy of Cyprus 2019 – 2030 [Action Plan for period 2019 - 2022].* Nicosia: 2019

[6] Parliament of Cyprus, *Meeting of the Parliament, Fourth Industrial Revolution: Enforced Actions. Conference Proceedings.* Nicosia: Research and Publications Office, 2019. Retrieved from: http://www.parliament.cy/images/media/assetfile/Viomixaniki4%20B.pdf

[7] Industry for Development, *The New Industrial Policy of Cyprus 2019 – 2030 [Action Plan for period 2019 - 2022].* Nicosia: 2019

[8] Ministry of Health (2019). Information Systems Strategy Study for the Ministry of Health. Retrieved from: https://www.moh.gov.cy/MOH/MOH.nsf/All/B0517B350E960C58C22579F8001E4D7C?OpenDocument

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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 unhindered, 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.

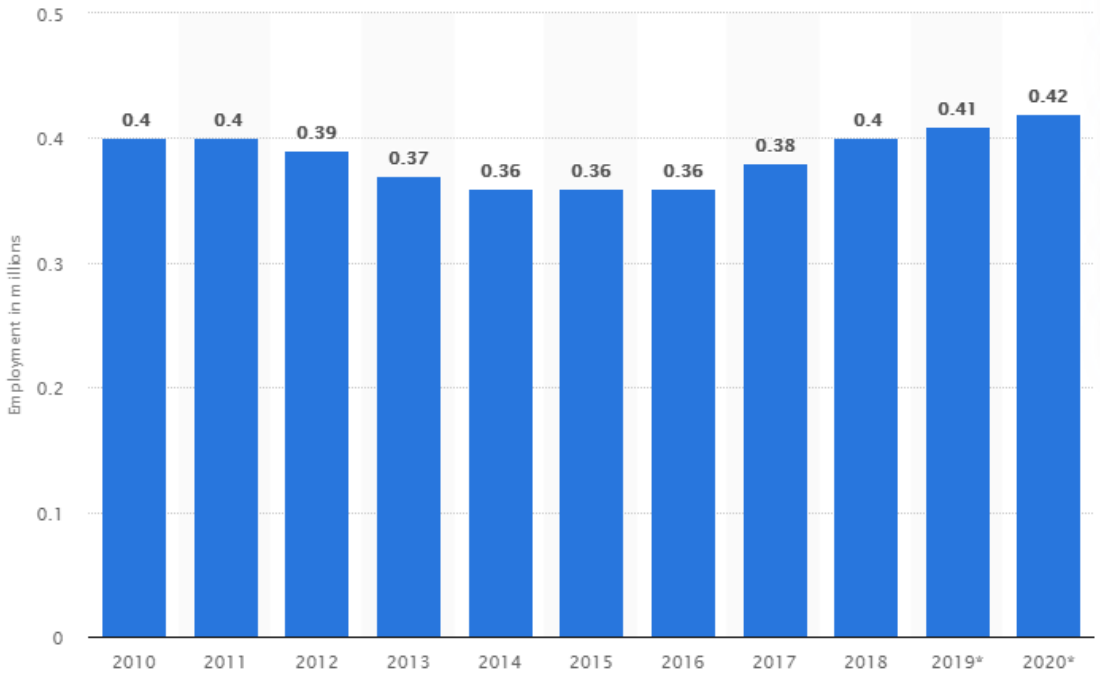
In the field of citizen-to-public communication, the digital transformation of the services offered can lead to the elimination of bureaucracy and the provision of excellent service to citizens, visitors and of public administration enterprises.

Concluding, as the digital transformation and the emerging trends in the labour market show above, the emerging technological trends are too close but yet far from the country.

2.1 Analysis of the labour market

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[9].

Table 1: Cyprus employment 2010 – 2020



Source: Statista 2020

[9] HRDA, *Addressing Employment and Training Needs in 2019*. EPALE, 2018.

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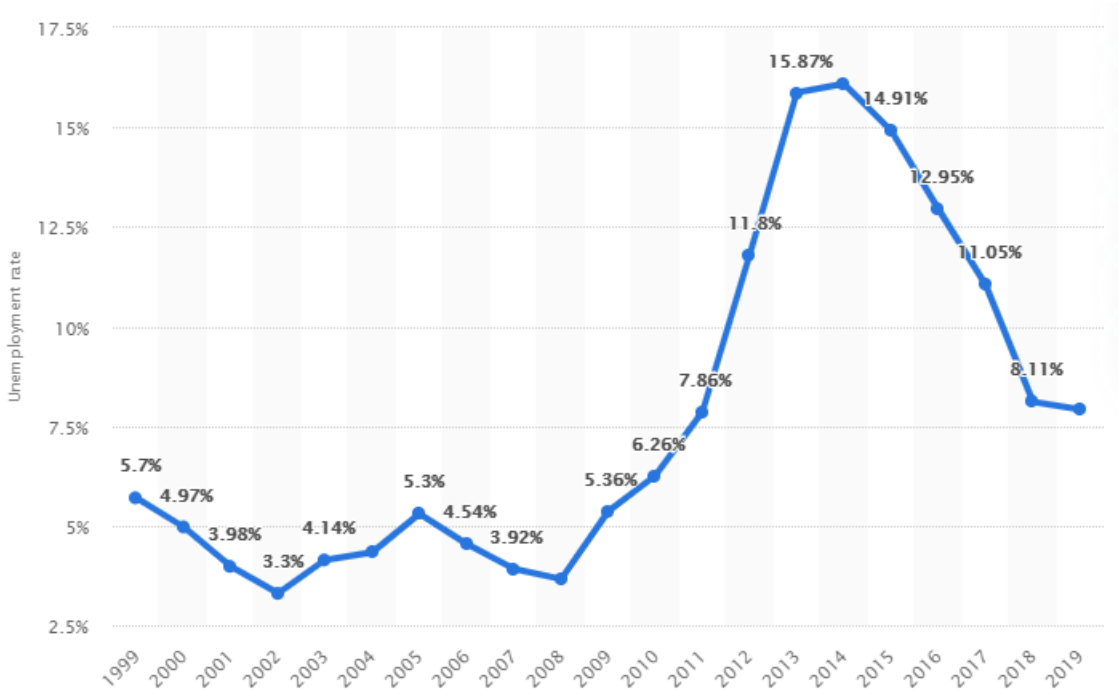
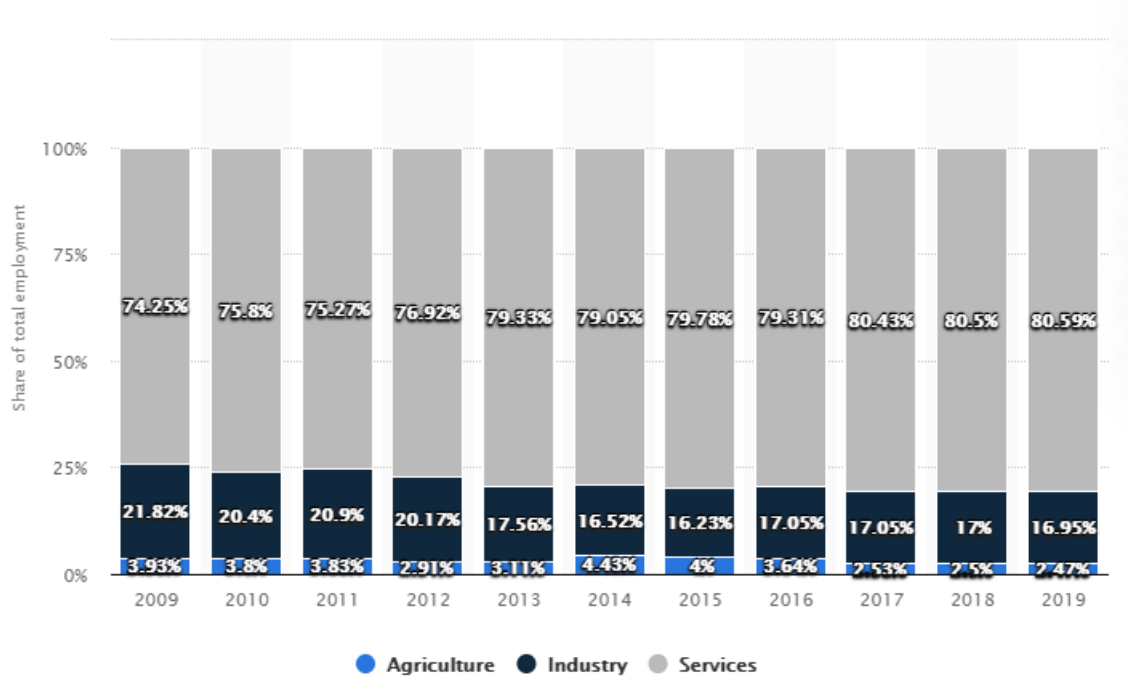
Table 2: Cyprus unemployment rate 1999 – 2019



Source: Statista 2020

Table 3: Cyprus distribution of employment by economic sector 2009 – 2019



Source: Statista 2020

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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, confirms the importance of timely and effective implementation of strategic employment and human resources development measures in Cyprus[10].

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 ones. types of deployments and 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.
- Promote 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 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

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

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knowledge and skills of the human resources of Cyprus through the implementation of continuing training programs.

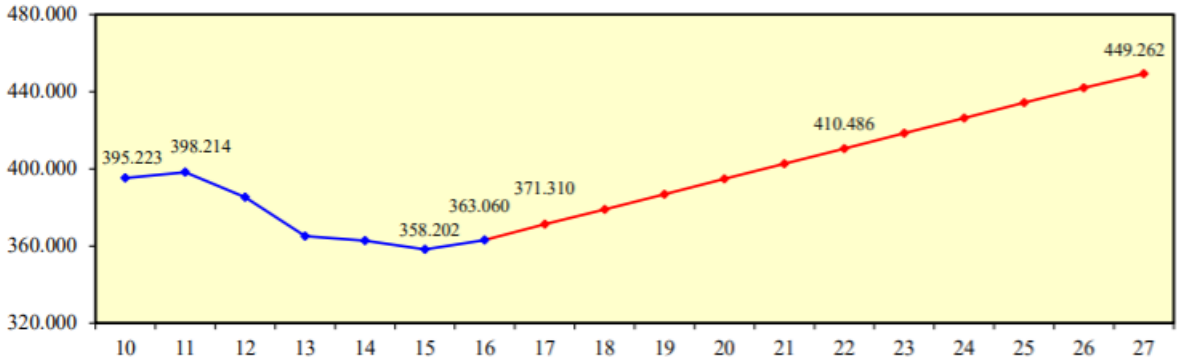
2.2 Prospective of employability

Total Employment

The Human Resource Development Authority of Cyprus (HRDA) has recently completed a research study providing forecasts of employment needs in the national economy for a 10-year period. The aim is to forecast employment needs in all economic sectors and in all occupations for the period 2017-27 in order to contribute to the planning and implementation of education and training activities. The forecasts cover three broad sectors, 21 main sectors and 52 sectors, and 309 occupations covering the whole spectrum of the Cyprus labour market. Systematic monitoring of employment trends over time and projecting the future situation of the labour market are key elements in improving the adaptability of human resources and promoting an effective and flexible labour market[12].

According to the HRDA the total employment in the period 2017-2027 is forecasted to exhibit an upward trend recovering gradually from the consequences of the recent economic crisis. It is forecasted that during the decade 2017-2027 employment will increase by 77.952 persons or 21,0%. It is noted that total employment from 2011 (398.214 persons) until 2015 (358.202 persons) had a significant drop as a result of the economic crisis (decrease by -40.012 persons or -10,0%) while in 2016, for the first time since the economic crisis, employment rebounded reaching 363.060 persons (increase by 4.858 persons or 1,4% compared to 2015)[13].

Table 4: Total employment for the period 2010 – 2027



Source: anad.org.cy

[12] CEDEFOP, Cyprus: Employment Forecasts 2017 – 2027. Retrieved from: https://www.cedefop.europa.eu/en/news-and-press/news/cyprus-employment-forecasts-2017-27-1

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

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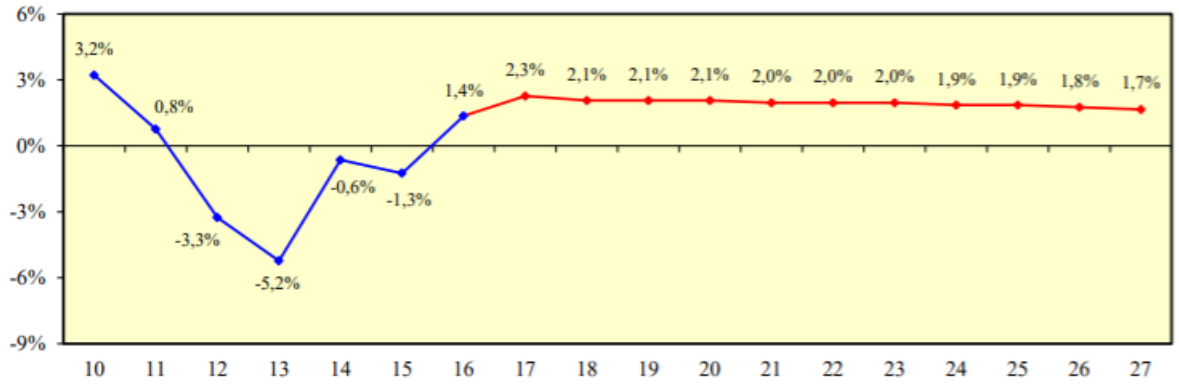
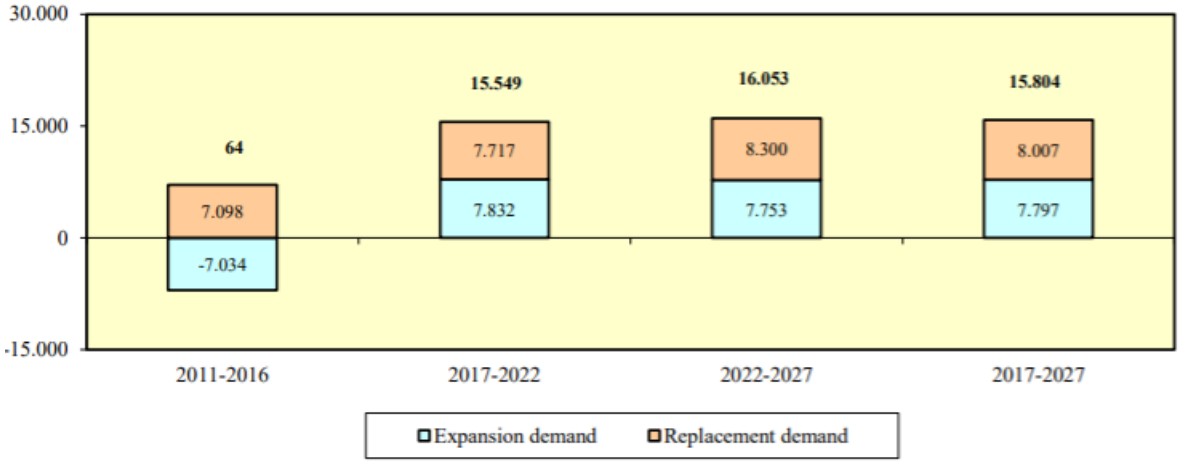
Table 5: Annual percentage change in employment for the period 2010 -2027



Source: anad.org.cy

Annual employment demand for the period 2017-2027 will reach 15.804 persons with an average annual rate of 3,9%. Expansion demand, or new jobs, is forecasted to be 7.797 persons or 1,9% per year and will be slightly lower than the employment needs due to permanent withdrawals from the labour market which will be 8.007 persons or 2,0% per year[14].

Table 6: Annual average total employment demand for the period 2011 – 2027



Source: anad.org.cy

Economic Sectors

According to the HRDA, the vast majority of employed persons 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.

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

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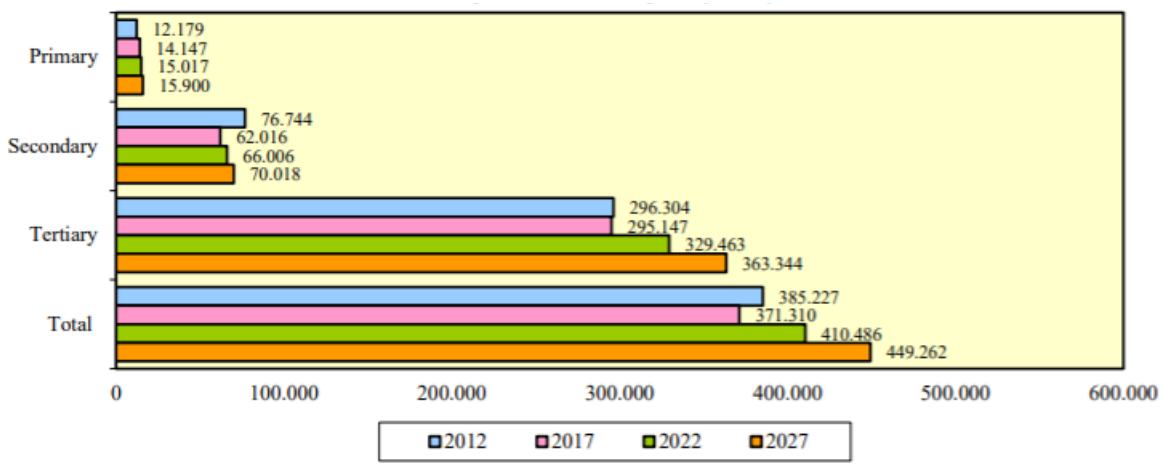
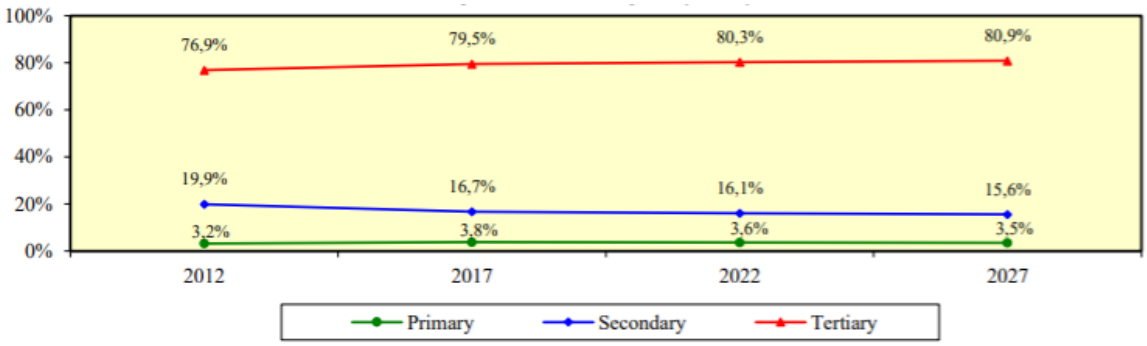
Table 7: Employment forecasts in broad economic sectors for the period 2017 – 2027



Source: anad.org.cy

Table 8: Employment shares in broad economic sectors for the period 2012 - 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:

- 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 defense (820 persons or 2,7% per year)
- Arts, entertainment and recreation (477 persons or 6,1% per year)

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- Other service activities[15] (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) [16]

Occupations

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)[17].

Table 9: Employment forecasts in broad occupational categories for the period 2017 – 2027

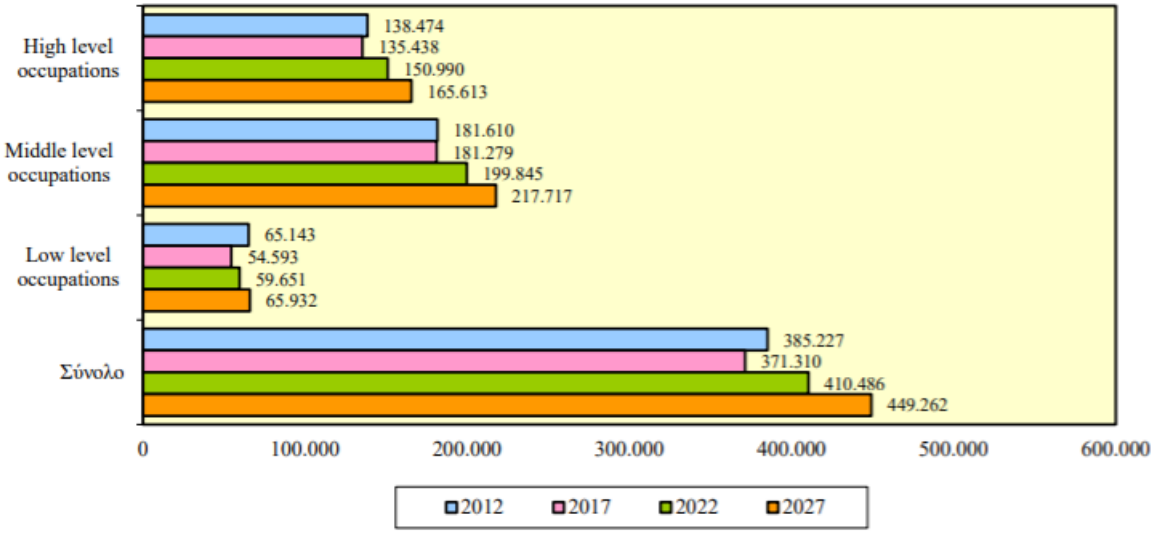
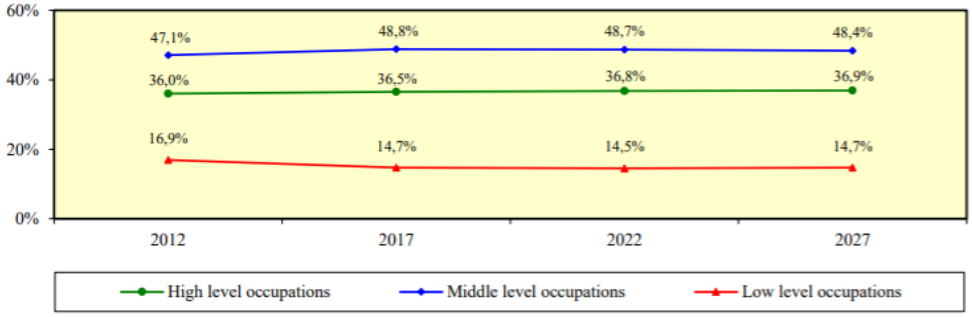


Table 10: Employment shares in broad occupational categories for the period 2012 – 2027



Source: anad.org.cy

[15] 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.

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

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

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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:

- Accounting associate professionals (461 persons or 4,7% per year)
- Legal professionals (254 persons or 4,5% per year)
- Nursing and midwifery professionals (230 persons or 3,7% per year)
- Accountants (157 persons or 3,1% per year)
- Secondary education teachers (141 persons or 1,7% per year)
- Teaching professionals not elsewhere classified (136 persons or 6,0% per year)
- Credit and loans officers (118 persons or 2,6% per year)
- Commercial sales representatives (112 persons or 2,0% per year)
- Journalists (101 persons or 7,1% per year)
- Trade managers (100 persons or 4,8% per year)
- Applications programmers (97 persons or 3,4% per year)
- Primary school teachers (96 persons or 2,0% per year)
- Construction supervisors (89 persons or 3,4% per year)
- Medical doctors (88 persons or 3,2% per year)
- Financial and insurance services branch managers (87 persons or 5,2% per year)
- Other language teachers (81 persons or 6,1% per year)
- Armed forces (75 persons or 1,6% per year)
- Sales and marketing managers (73 persons or 3,9% per year)
- University and higher education teachers (73 persons or 3,4% per year)
- Administrative and executive secretaries (71 persons or 1,9% per year)
- Civil engineering technicians (70 persons or 4,0% per year)
- Pharmacists (62 persons or 5,5% per year)
- Economists (58 persons or 6,8% per year)
- Dentists (56 persons or 5,0% per year)[18]

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:

- Cashiers and ticket clerks (617 persons or 6,6% per year)
- General office clerks (595 persons or 4,1% per year)
- Waiters (567 persons or 5,8% per year)
- Shop sales assistants (535 persons or 3,4% per year)
- Car, van and motorcycle drivers (288 persons or 3,8% per year)
- Material-recording and transport clerks (268 persons or 5,1% per year)
- House builders (251 persons or 3,7% per year)
- Cooks (244 persons or 4,7% per year)

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

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- Secretaries (general) (234 persons or 4,1% per year)
- Heavy truck and bus drivers (228 persons or 4,0% per year)
- Shop keepers (203 persons or 3,6% per year)
- Hairdressers (189 persons or 4,3% per year)
- Police officers (172 persons or 3,4% per year)
- Beauticians (146 persons or 4,3% per year)
- Building caretakers (142 persons or 7,4% per year)
- Motor vehicle mechanics and repairers (138 persons or 3,5% per year)
- Information and communications technology servicers (134 persons or 6,3% per year)
- Bartenders (114 persons or 5,1% per year)
- Childcare workers (111 persons or 5,5% per year)
- Carpenters and joiners (110 persons or 3,9% per year)
- Market gardeners and crop growers (104 persons or 2,2% per year)
- Bakers, pastry-cooks and confectionery makers (103 persons or 4,1% per year)[19]

Concluding, 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.

3. IIoT in Cyprus: concept and current state of implementation

According to the Digital Economy and Society Index (DESI) 2018xxi, "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"[20].

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[21].

In regard to the integration of digital technologies by businesses, Cyprus is making slow progress. Companies are using social media and e-commerce but are less willing to adopt new technologies,

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

[20] Industry for Development, *The New Industrial Policy of Cyprus 2019 – 2030 [Action Plan for period 2019 - 2022].* Nicosia: 2019

[21] Industry for Development, *The New Industrial Policy of Cyprus 2019 – 2030 [Action Plan for period 2019 - 2022].* Nicosia: 2019

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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%)[22].

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). EU). 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)[23].

Current situation

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[24].

Challenges

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 the 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

[22] Industry for Development, *The New Industrial Policy of Cyprus 2019 – 2030 [Action Plan for period 2019 - 2022].* Nicosia: 2019

[23] Industry for Development, *The New Industrial Policy of Cyprus 2019 – 2030 [Action Plan for period 2019 - 2022].* Nicosia: 2019

[24] Industry for Development, *The New Industrial Policy of Cyprus 2019 – 2030 [Action Plan for period 2019 - 2022].* Nicosia: 2019

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- 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[25].

Needed actions and initiatives

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

- Digitally empowering its competitors, such as tourism, and combining them with others not as competitive, such as health and education
- Investing in innovative ideas and new products
- Using open data, with a measurable goal of making a positive contribution to the national GDP
- Seeking to have an application centre in the wider area of artificial intelligence
- 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
- Seeking to develop into new areas, such as Blockchain, as a regional centre of excellence in the Eastern Mediterranean
- Adopting the digital world in the whole of public administration and encourages its adoption by all citizens and their activities
- Encouraging young people, in particular women, to acquire the appropriate new skills or to pursue science, technology, engineering and mathematics (STEM)
- Establishing the appropriate regulatory framework for controlling algorithms and their impact to avoid possible risks to human privacy and autonomy[26].

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[27].

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4. IIoTNet and training needs in Cyprus

Cyprus is currently among the last countries in terms of digital maturity. According to the empirical research and online survey that will be analysed in the next sections, the country lacks information, knowledge and training on the IIoT, as to be able to effectively introduce Industry 4.0 and its technologies to the various sectors of the island.

Nevertheless, with the adequate effort put in effective IIoT education training, Cyprus can get to the core of the digital economy and society because of its rich reserves of know-how, science, determination and hard work that enables the country to not only be modernized and to keep up with the new smart age, but also to pioneer. 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.

4.1. Methodological outline of the empirical research

For the needs of the first stage of the IIoTNet project development, all partners have carried out an online survey, obtaining a minimum of 100 responders for each country. The aim of the survey was to find out the organizations' current status in relation to the Industry 4.0, in particular the IIoT technologies and to produce a transnational report about possible support for SMEs in meeting the demands of Industry 4.0 (IIoT technologies).

The target groups of the online survey were decision makers, experts, professionals and VET providers related to the IIoT field. The 106 responders of the online survey in Cyprus came from large companies, associations, SMEs, VET institutions and universities/colleges. The main objectives of the online survey were to identify the current situation, the issues, the needs and some recommendations from our target groups regarding Industry 4.0 in Cyprus.

4.2. Online survey analysis

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%) (see Table 11). 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%) (see Table 12). 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.

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Table 11

5. Which of the below listed target groups do you represent?

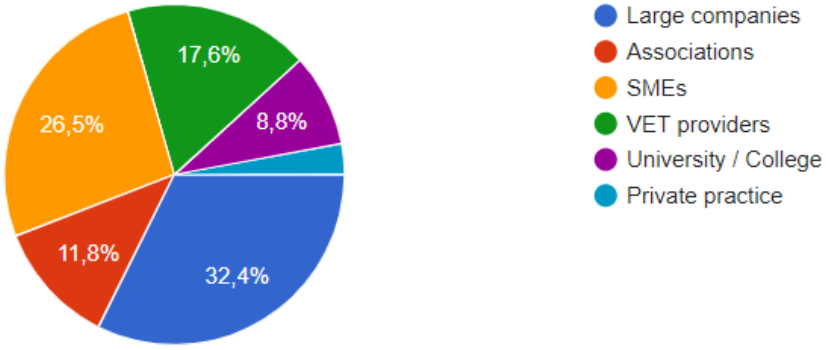
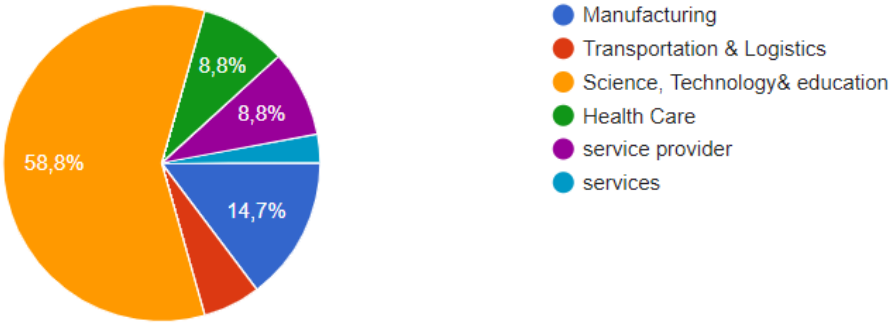


Table 12

6. Which industry do you represent



Based on the analysis, the 52,9% of the responders own an IoT product, while 44,1% do not own it. From the ones owning a product, 76,2% use an app to manage their device(s), versus 19% who do not. Most common IoT owned devices include the smartwatch (77,8%), the personal fitness tracker (38,9%) and the virtual reality set (16,7%). When it comes to the personal usage of technology and the Internet, as Table 13 shows, the vast majority of the responders claim that technology has a very significant role in their current life (79 out of 106), they are very dependent on it for ease of communication (80 out of 106), they are very active on social media (73 out of 106), and 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.

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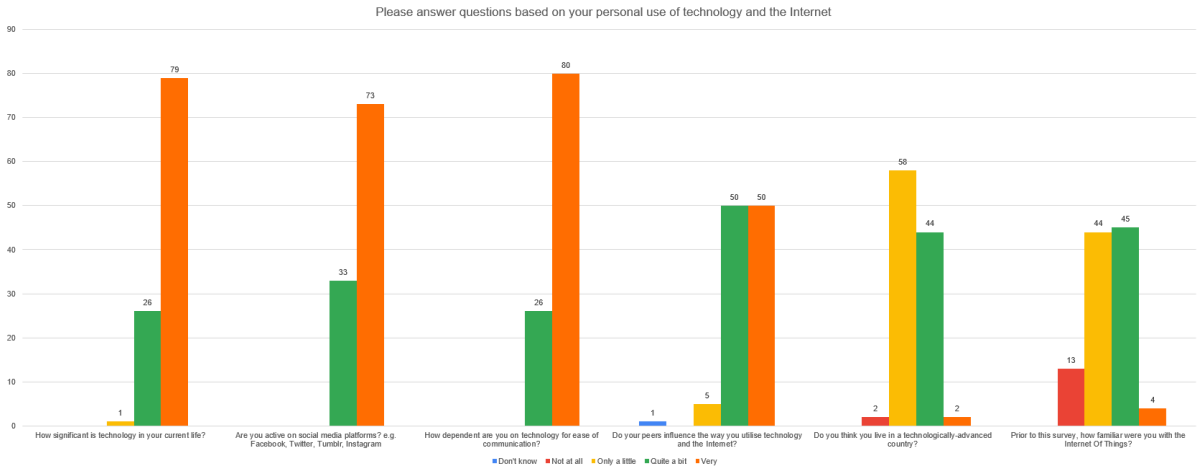
Table 13



In terms of the responders' knowledge regarding the term 'IIoT', most of them stated that they did not have any knowledge of the term (44,1%), while a 32,4% responded that they have a general idea of the term ('It has something to do with Industry and IoT') and a 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, a 41,2% claimed ignorant of the benefits, while a 35,3% had a vague idea ('Might help somehow in some industry applications') and a 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 responders stated that they believe IIoT would help them and their enterprise to improve their services (47,1%), but a 62,9% claimed ignorant on if and how the IIoT can improve their companies. On the same note, most of the survey participants stated ignorant on the problems of the IIoT (55,9%), with only a 29,4% claiming a general knowledge on the IIoT problems ('Problems with the application of IoT in Industry'), and only a 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 responders (85,3%) stated that the biggest obstacle is the lack of information and the need of education and training, with a 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 a 73,5% chose Health Care and 50% Transportation & Logistics (see Table 17).

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Table 17

13. In what sector do you believe that the IIoT would be more important? (multiple selection possible)

For the introduction and the implementation of IIoT in the companies, the majority of the responders (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 an 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%). A 32,4% of the responders, state that the formulation should be done by the management and a 17,6% stated 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 a 20,6% stating that they are not aware if such policy exists. On the same matter, a 52,9% of the participants stated that there aren't any national IIoT policies in the country, with a 38,2% claiming unaware if such IIoT policy exists. On the implementation strategies a 94,1% of the responders stated that the implementation should happen through education and training, a 76,5% through experts' opinion and by using national strategies and good practices, and 70,6% through the investment in modern technologies (see Table 18).

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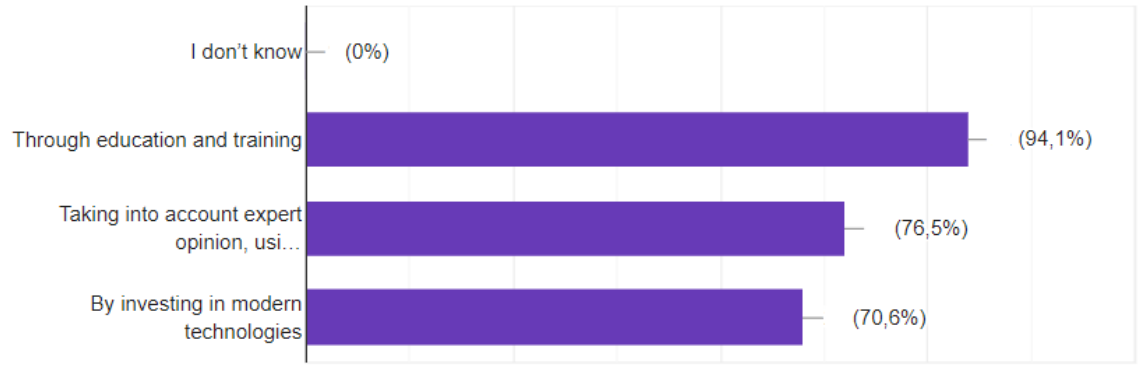
Table 18

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



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 responders (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%) (see Table 19). On the other hand, when asked about the main incompetence of the companies in the country, the participants reported the training (79,4%) and the knowledge and expertise in IIoT (76,5%) as the main incompetence and thus needs in IIoT for a company. Other needs include the guidance and guidelines (64,7%), the needs in funding (20,6%) and the need for best practices (11,8%) (see Table 20).

Table 19

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

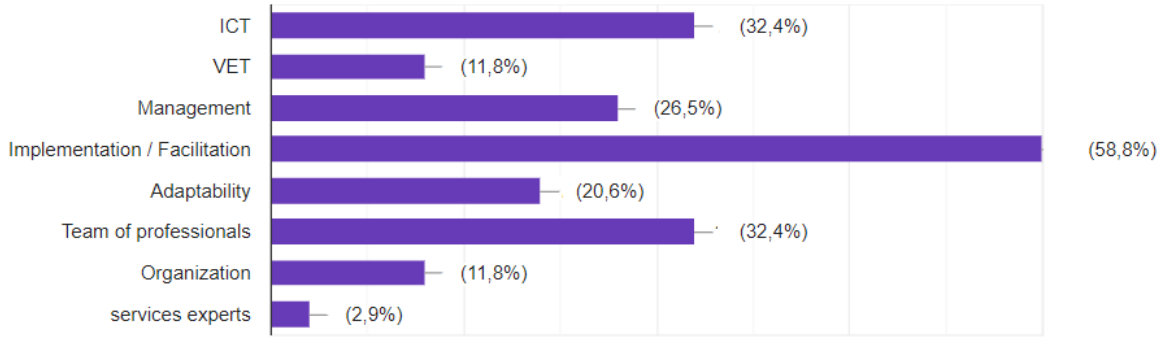


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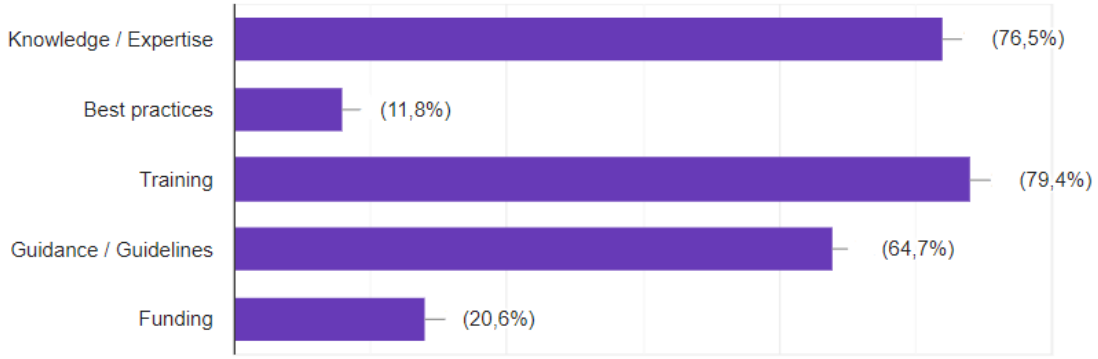
Table 20

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



On the questions about the importance of technology in a variety of aspects, the responders 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, a 41 out of 106 of the participants responded that the SMEs are incapable of delivering a training and a 29% that they were poorly capable. On the contrary, 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 responders 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 the contrary, the responders 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) (see Table 21).

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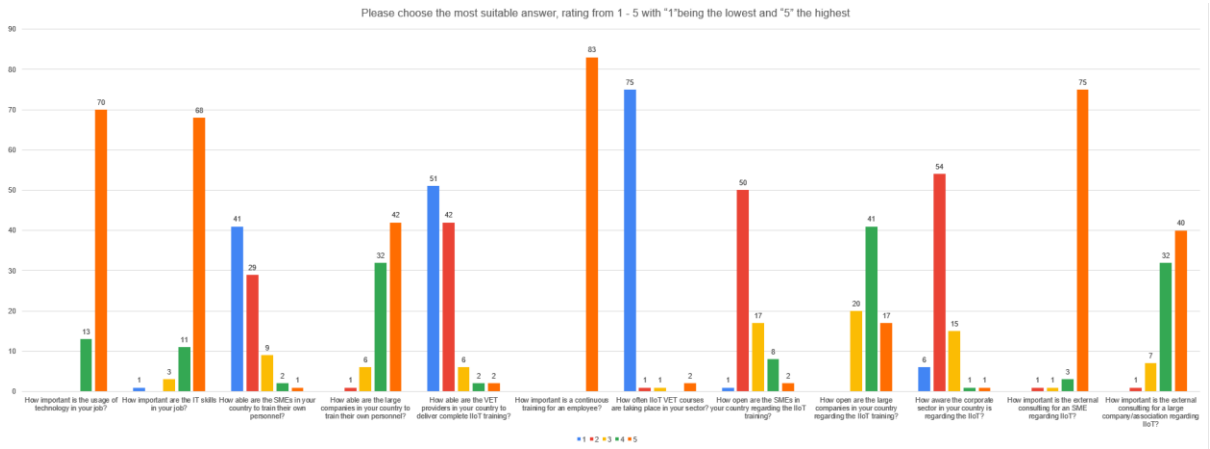
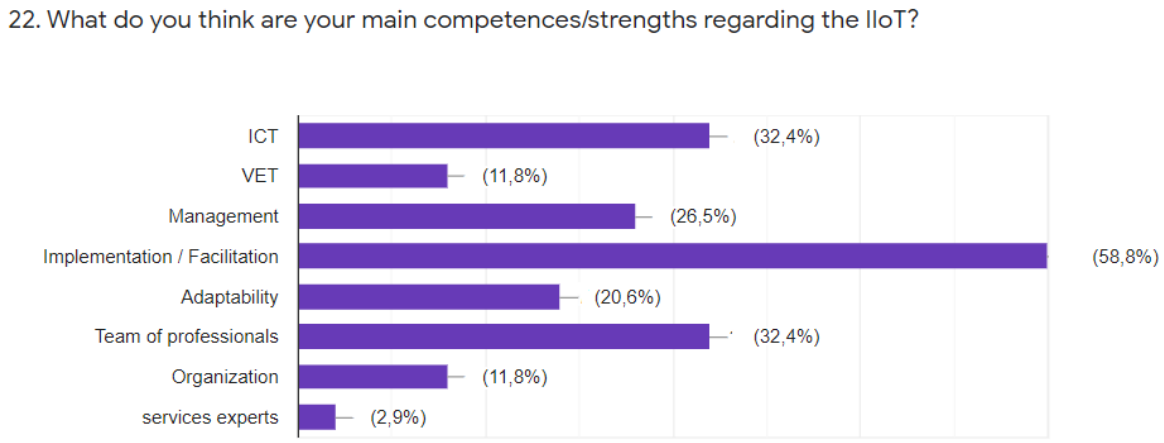
Table 21



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 a 20,6%) stating that only e-learning is enough for an efficient training. The vast majority of the responders (91,2%) stated that there are not any initiatives on behalf of their enterprise on IIoT/IoT, with only an 8,8% stating that they have such initiatives. According to the responders neither at national level, such initiatives exist (79,4%). When asked bout the training needs of the enterprises, most of the responders reported that a full, all-inclusive training is needed (85,3%), with only an 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. (see Table 22).

Table 22



Regarding the type of certification of an IIoT training, a 44, 1% of the participants responded that a certificate of achieved results should be provided, while a 35,3% of the responders reported that a simple certificate of attendance should be enough. Only an 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 an 8,8% reported that the best certificate should be a certificate with recommendation/granted rights to continue with additional VET training.

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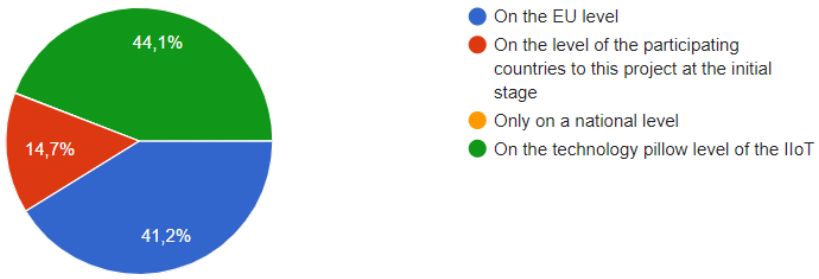
When it comes to the usage of IIoT products, a 67,5% of the participants reported that they do not use such products in their enterprise and only a 23,5% reported that they do. The majority of the participants stated that the most related industry to their knowledge or interest on IIoT products is Science, Technology & Education (64,6%) with only a 23,5% stating manufacturing as their most related industry. Other related industries included health care, transport and services. When asked if for the IIoT in their sector, there is a need to specify in more details the types of used sensors (IIoT devices), the majority responded that they do not have knowledge on this, with only a 20,6% stating that there is such 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 a 26,5% stated that there is not such a need, and a 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 responders, 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 the 39,3% stated that the responsible should be a designated person at the industry level of the IIoTNet.

In regards 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%) (see Table 23).

Table 23

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



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 a 47,1% opining that there is a need for the creation of level of management for each group of interest, an 11,8% supporting the creation of function keys for

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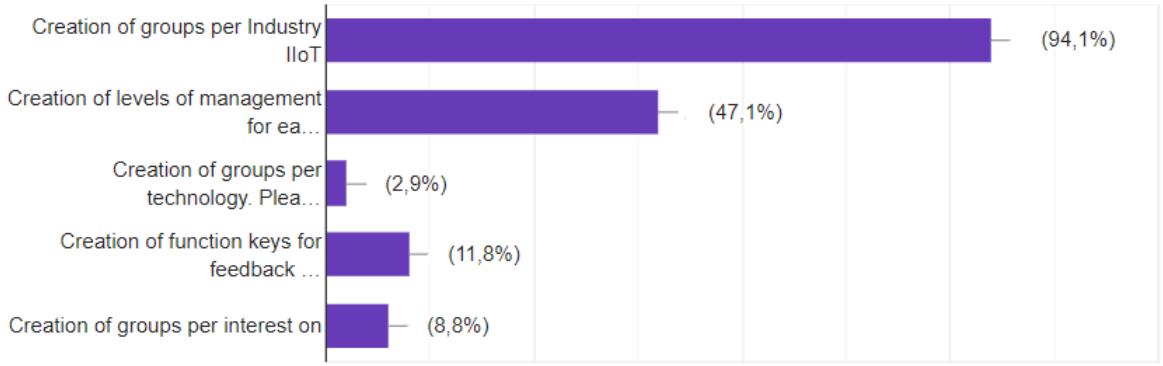
feedback intended for upgrade of the IIoTNet, an 8,8% the creation of groups per interest and a 2,9% the creation of groups per technology (see Table 24).

Table 24

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



Regarding the IIoTNet meetings, most responders answered that the best way is through e-meeting tools (82,4%), with only a 17,6% stated that there is a need for at least once per year to meet physically in a specific country town. A 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 – this requiring small payment to a person supporting this dynamic functioning of the website (73,5%). The rest of the responders answered that they do not know (14,7%) and an 11,8% reported they do not envisage such service.

When asked about the envisaged establishments of core functions of the IIoTNet, a 91,2% of the participants stated that the functions should include a link between IIoT providers, a 79,4% that there should be a link between IIoT service providers included, a 76, 5% supported a link between IIoT and VET providers, a 70,6% a link between IIoT end-users and appropriate creators/consultants/service providers, and a 64,7% a link between IIoT university/college educators (see Table 25).

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Table 25

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

When asked how the Big Data environment (e.g. Hadoop systems) can support the IIoT, half of the responders opined that this should be done on a large scale for a full IIoT data analysis (47,1%), while a 26,5% stated that they do not plan to use Hadoop system for the repository of IIoT data, and a 14,7% of them stated that only the big IIoT files should be stored there (see Table 26).

Table 26

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

In terms of data, the vast majority of the responders claimed that manufacturing (82,4%) will be the industry generating the biggest amount of data, with just an 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.

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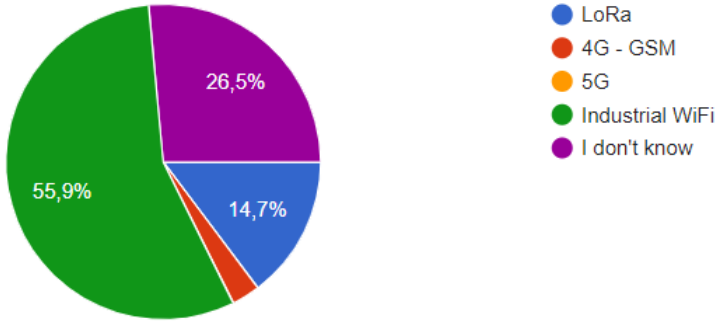
When it comes to the type of network that the responders expect to use for transferring the data from IIoT devices, more than half of the responders (55,9%), reported that an Industrial Wi-Fi should be efficient, a 26,5% claimed unaware of the type of network, and a 14,7 % reported LoRa network (see Table 27).

Table 27

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



Finally, almost half of the participants state that they expect a special ICT architecture to collect the data from their IIoT (44,1%), with a 38,2% stating they do not such service and a 17,6% stating that they do not know. A 47,1% reported that they expect to use a special methodology for collection of data from IIoT devices (47,1%), while a 35,3% stated that they do not expect such methodology and a 17,6% did not opine. Lastly, almost half of the responders answered that they do not know if they see a role of Industry 4.0 in the creation of IIoTNet, while a 32,4% stated that they do not see such role and a 23,5% stated that they do.

5. Conclusion

Concluding, according to the empirical research and online survey, Cyprus is currently among the last countries in terms of digital maturity. The country lacks information, awareness, expertise, knowledge and training on the IIoT, as to be able to effectively introduce Industry 4.0 and its technologies to the various sectors of the island. 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.

Cyprus must introduce national IIoT (Industry 4.0) policies as well as to 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 in the country should be developed through adequate education and

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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.

With the adequate effort put in effective IIoT education training, Cyprus can get to the core of the digital economy and society because of its rich reserves of know-how, science, determination and hard work that enables the country to not only be modernized and to keep up with the new smart age, but also to pioneer. 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.

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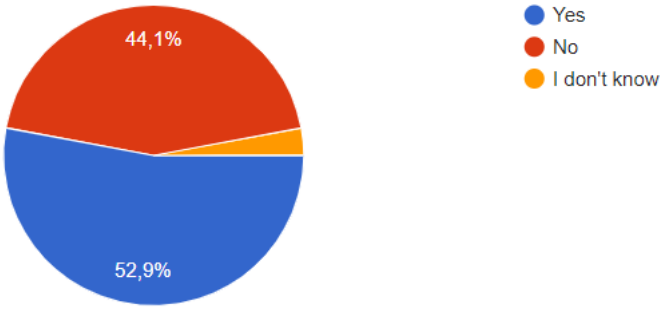
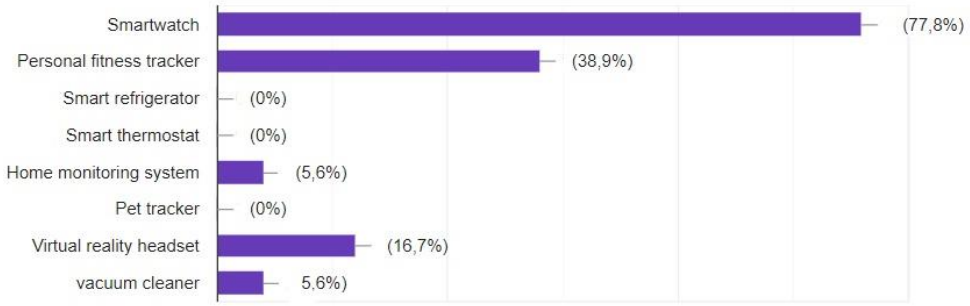
Annex

IIoTNet Online Survey Results - Cyprus

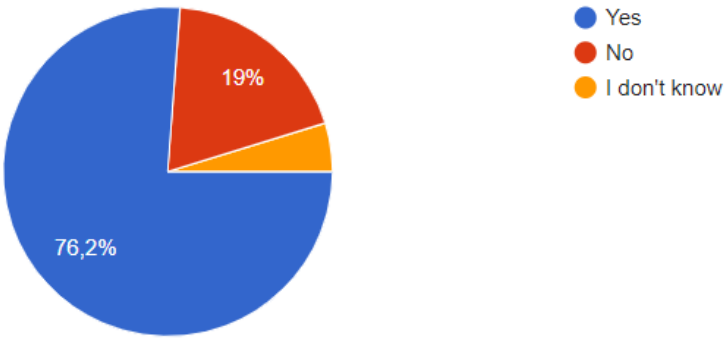
1. Do you own an Internet Of Things (IoT) product?



2. If yes, which IoT product(s) do you own. Select all that apply:



3. If you have, do you use an app to manage your IoT devices?



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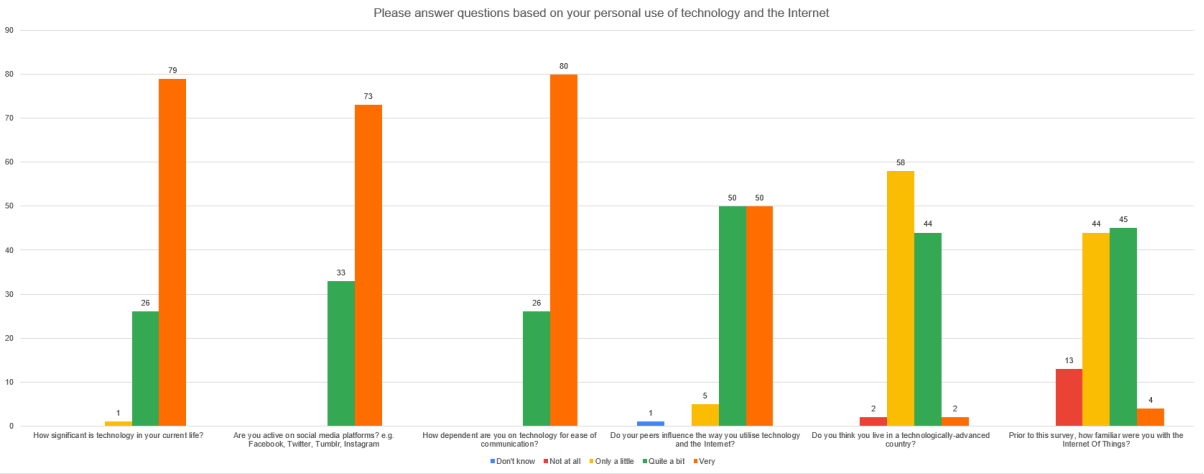
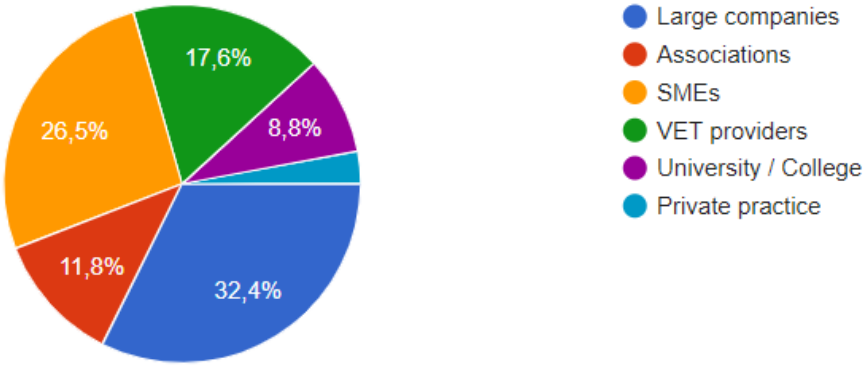
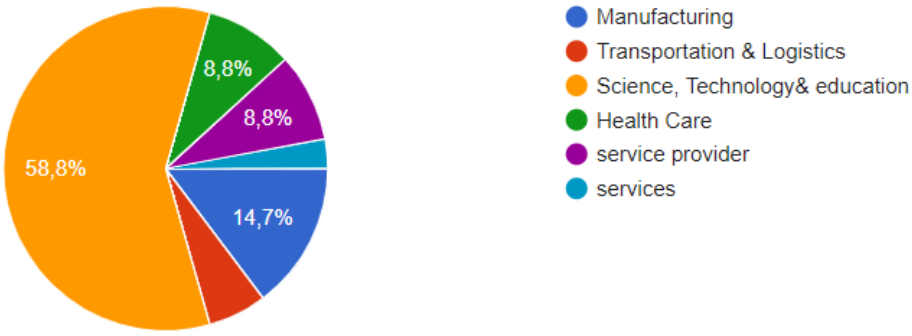


5. Which of the below listed target groups do you represent?



6. Which industry do you represent



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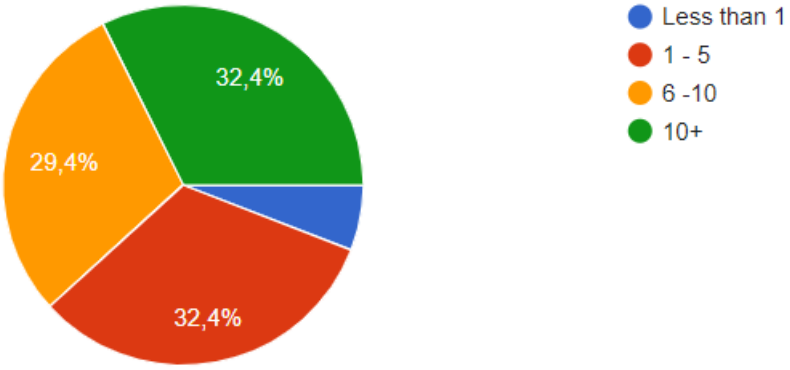
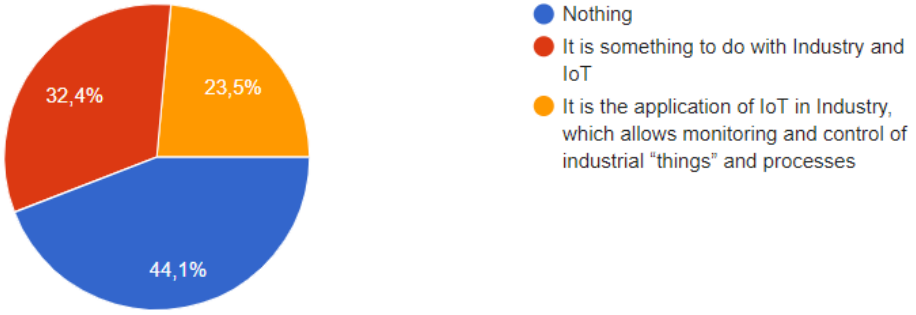
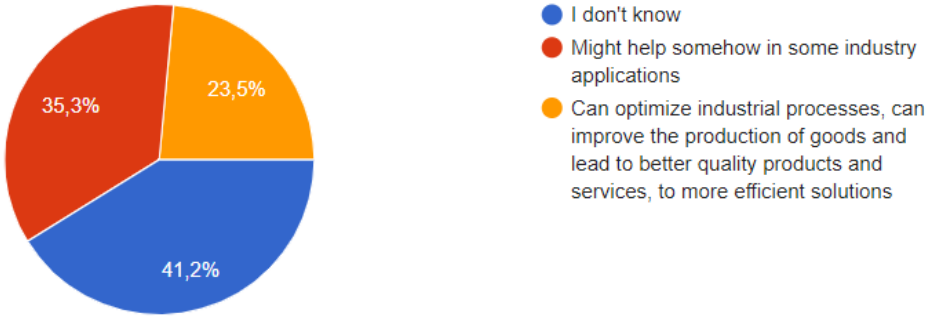
7. How many years of experience do you have in the sector?



8. What do you know of Industrial IoT (IIoT)?



9. What are the benefits from IIoT?



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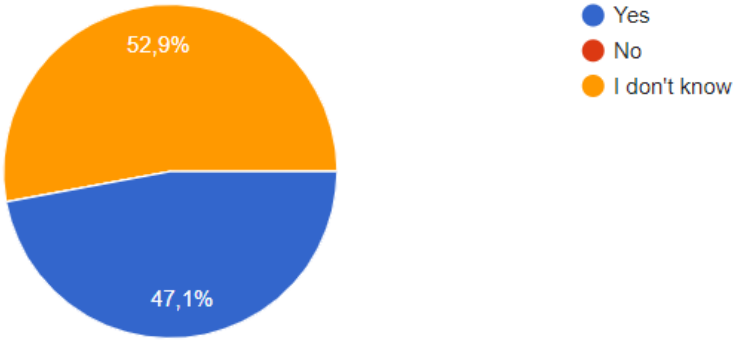
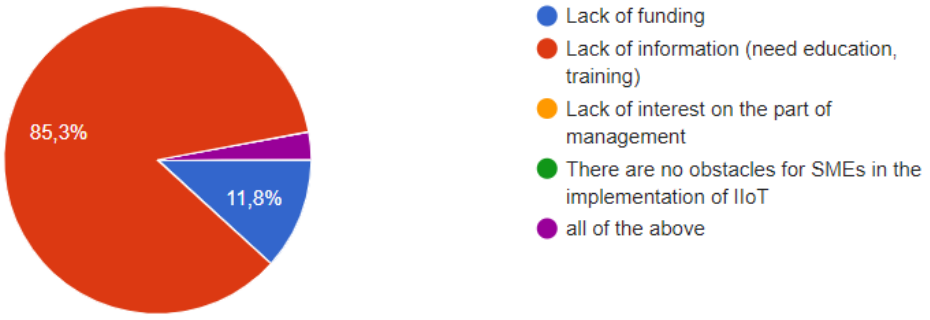
10. Do you think the IIoT would help you and/or your enterprise improve your service?



11. What are the problems in IIoT?

12. What are the biggest obstacles for SMEs in the implementation of IIoT?



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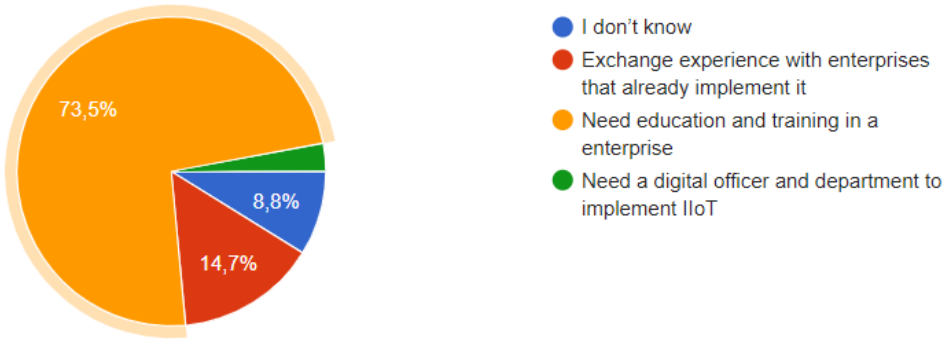
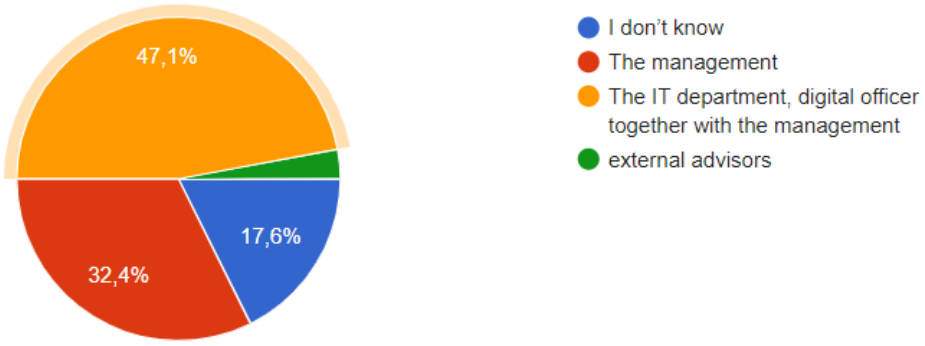
13. In what sector do you believe that the IIoT would be more important? (multiple selection possible)

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



15. Who should formulate the objectives of IIoT?



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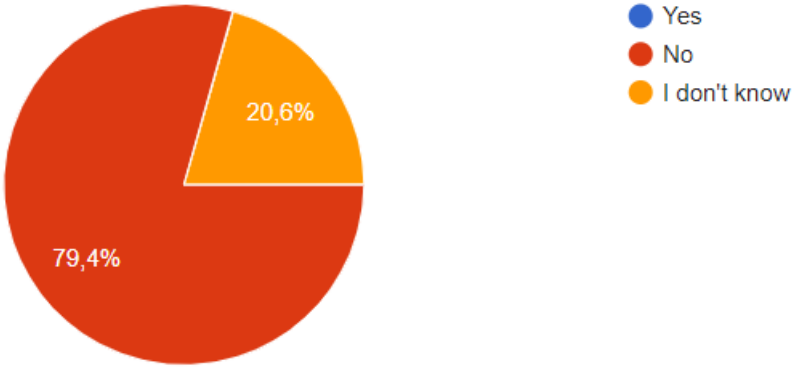
16. What kind of a structure in the enterprise is needed for the creation and management of IIoT?

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



18. Are there national IIoT policies?

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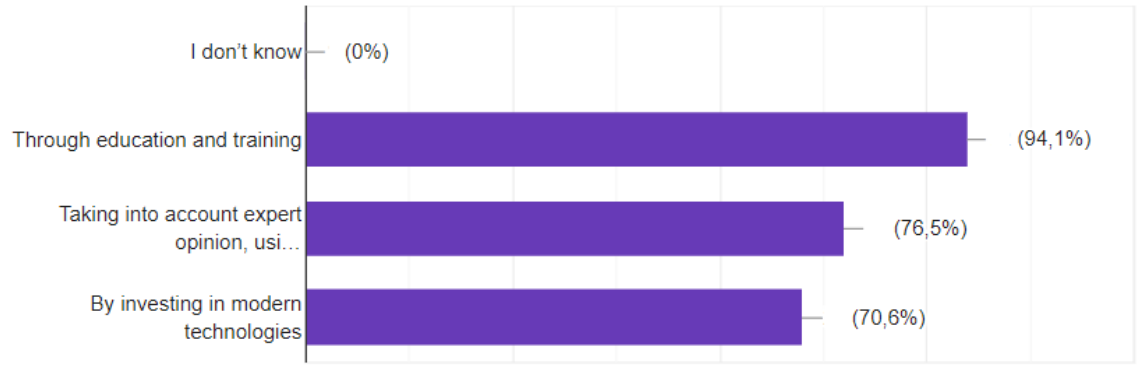
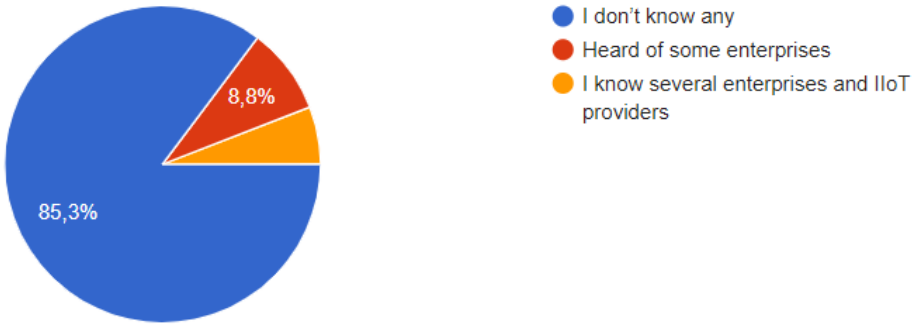
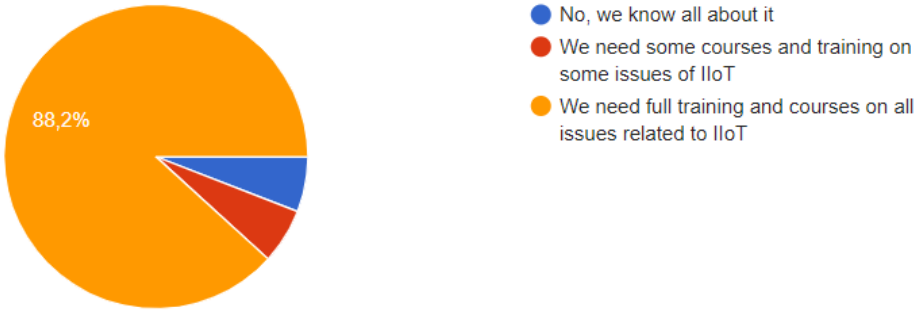
19. How do you expect to implement IIoT? (multiple selection possible)



20. How many IIoT providers do you know?



21. Do you need training and consultancy for the introduction and implementation of IIoT?



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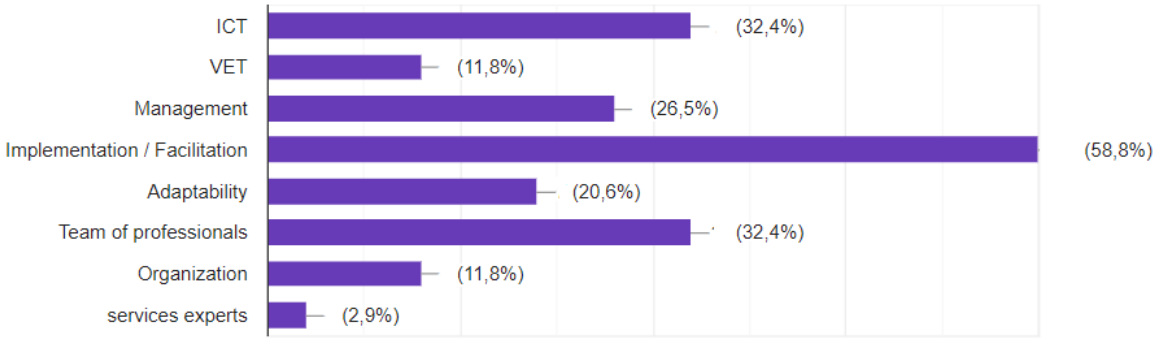
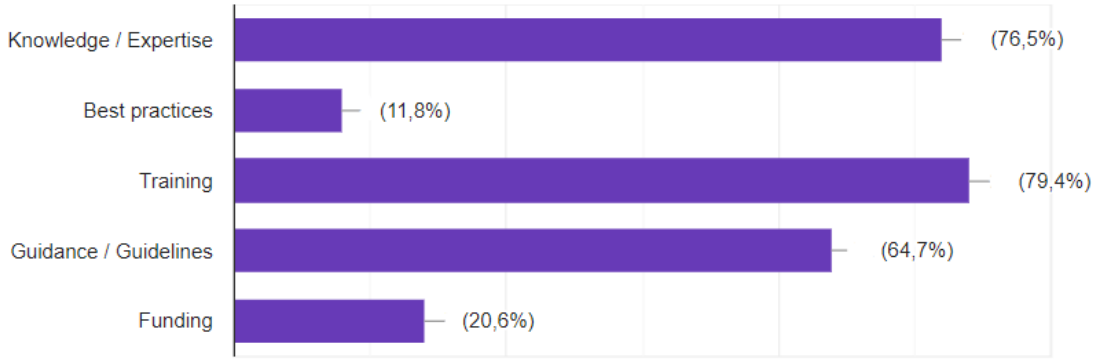
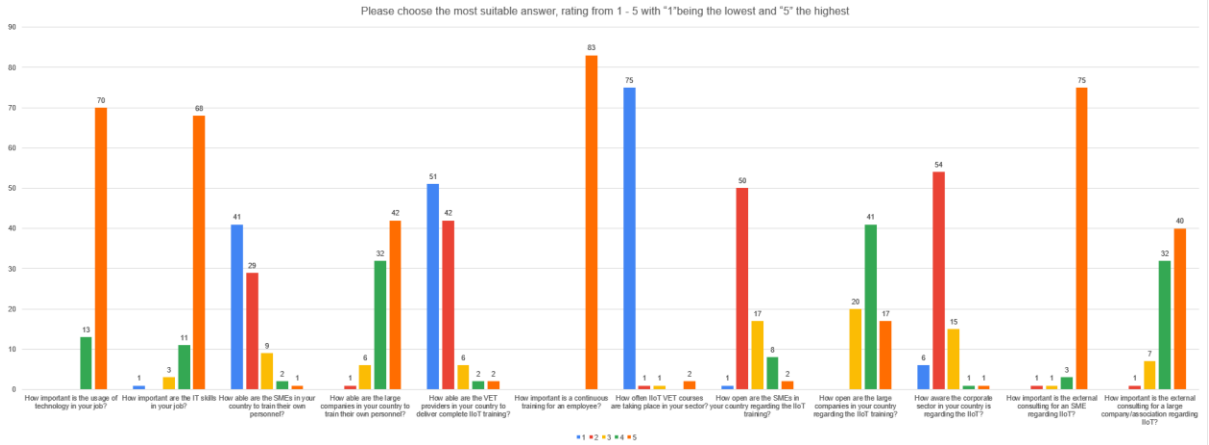
22. What do you think are your main competences/strengths regarding the IIoT?



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





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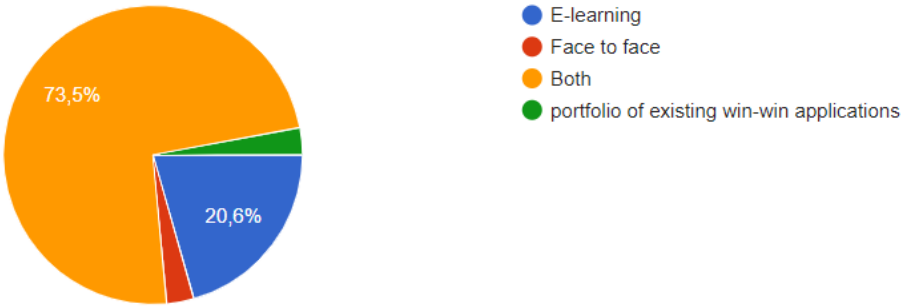
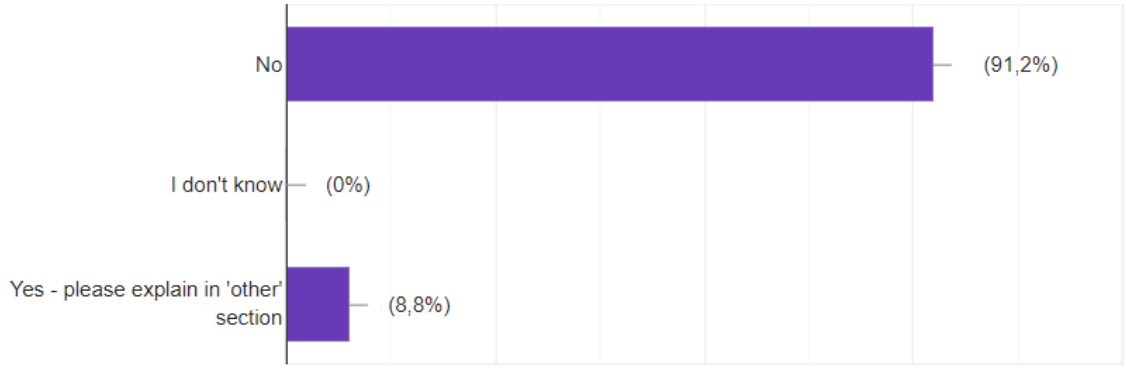
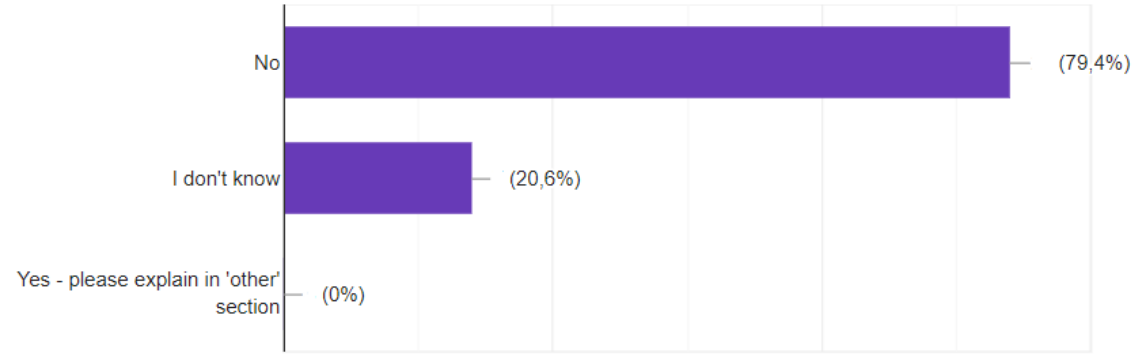
25. What do you believe is the most efficient way of training?



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



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



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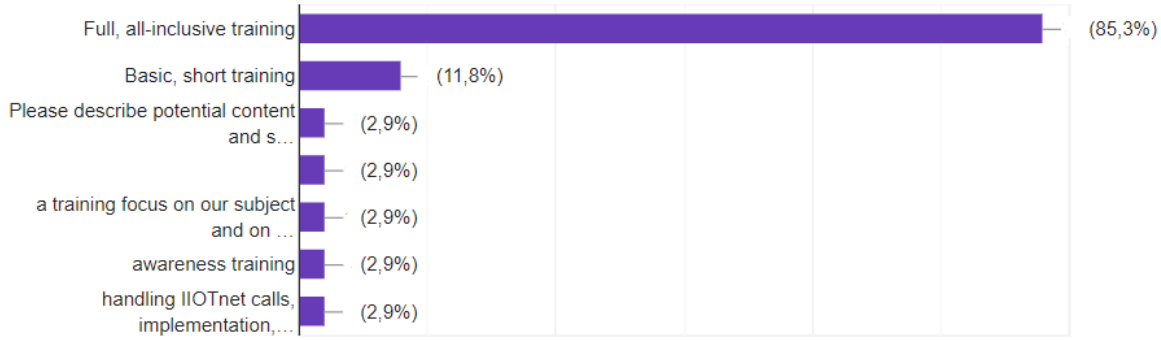
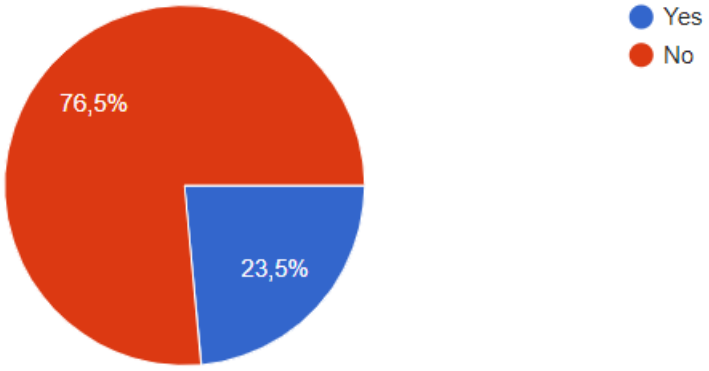
28. What kind of a training would be the most efficient for you and your enterprise? Please describe potential content and structure:



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

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



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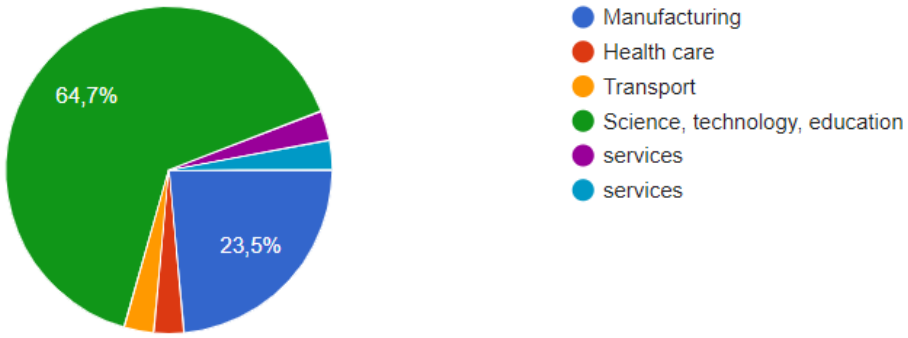
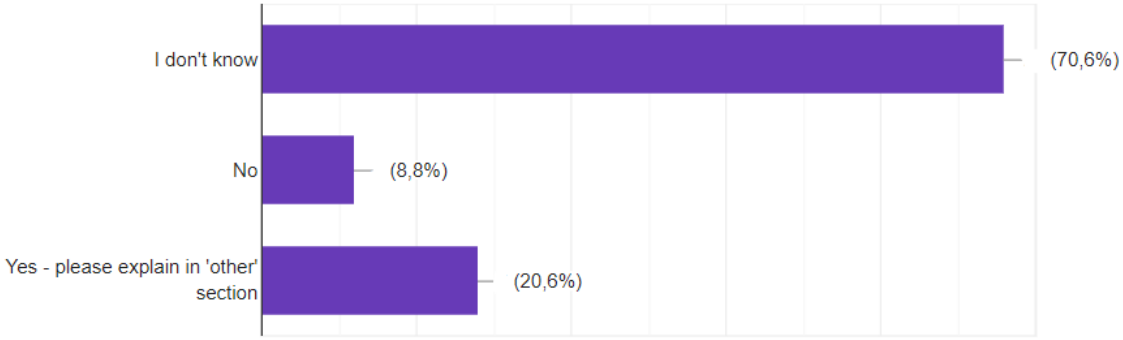
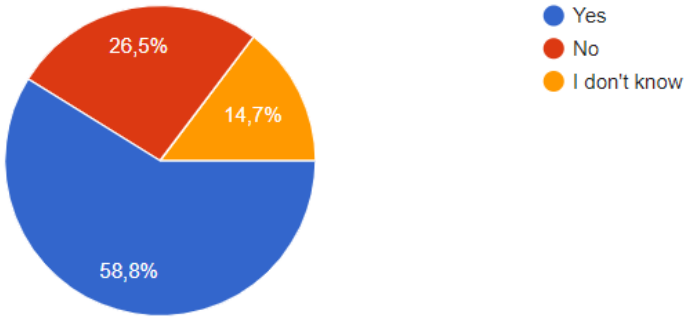
31. Which industry is related to your knowledge/interest about IIoT products? (multiple selection possible)



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



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



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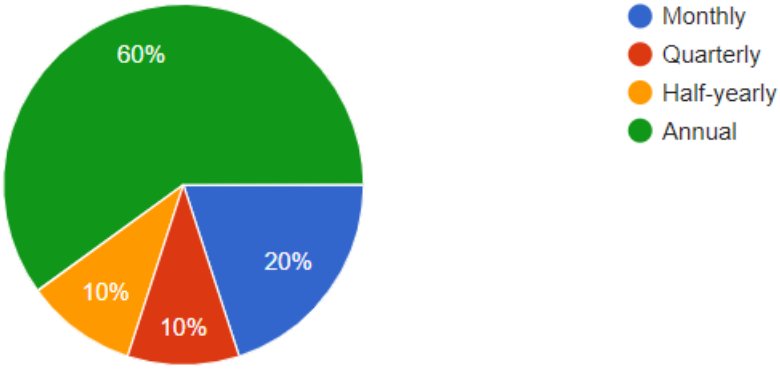
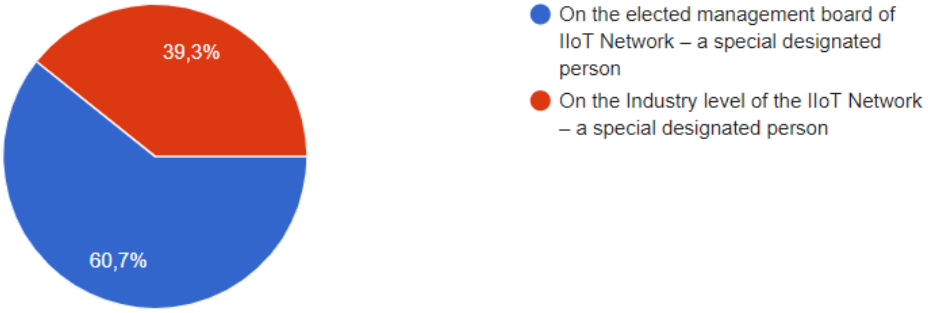
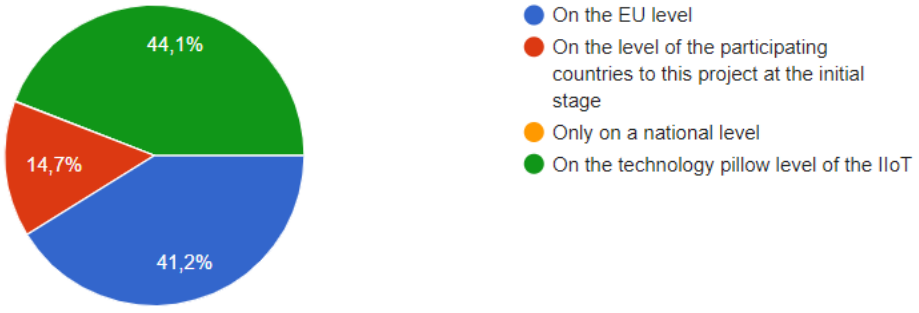
34. If yes, how frequent should the distribution be



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



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



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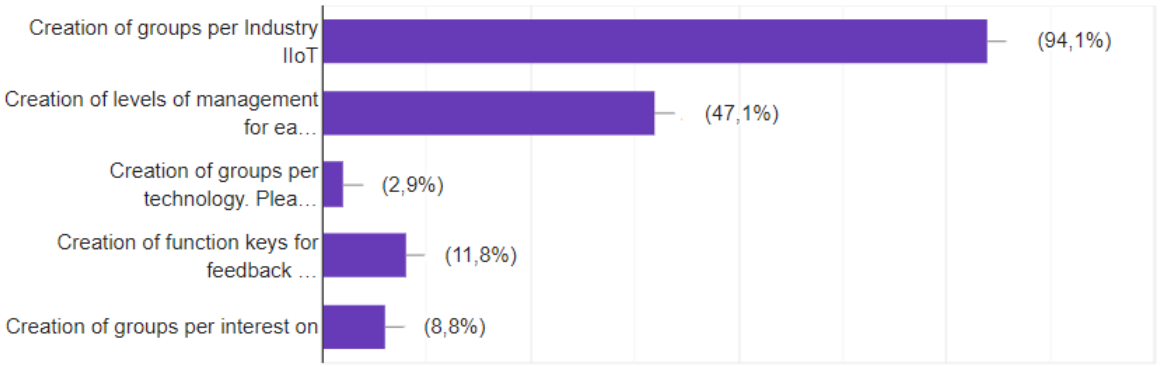
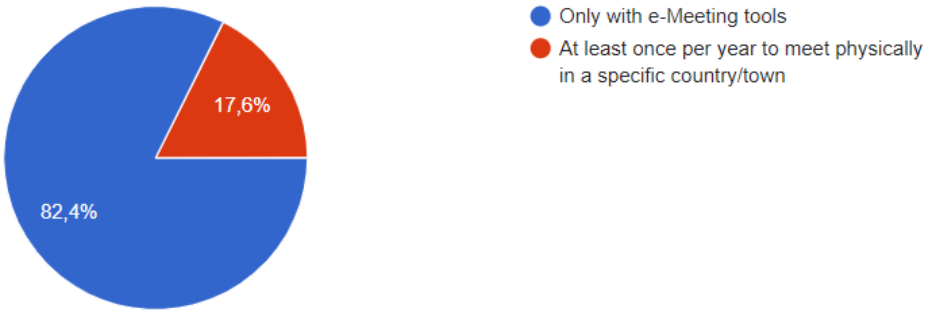
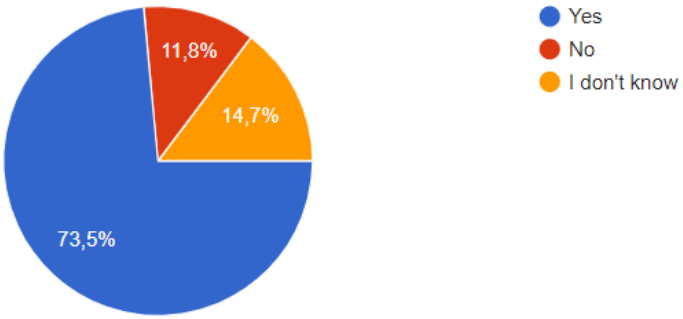
37. To support the IIoT Network, we will use a dedicated private Social Network. What kind of functions of this Social Network do you envisage to be the most important to facilitate the IIoT Network



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



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)



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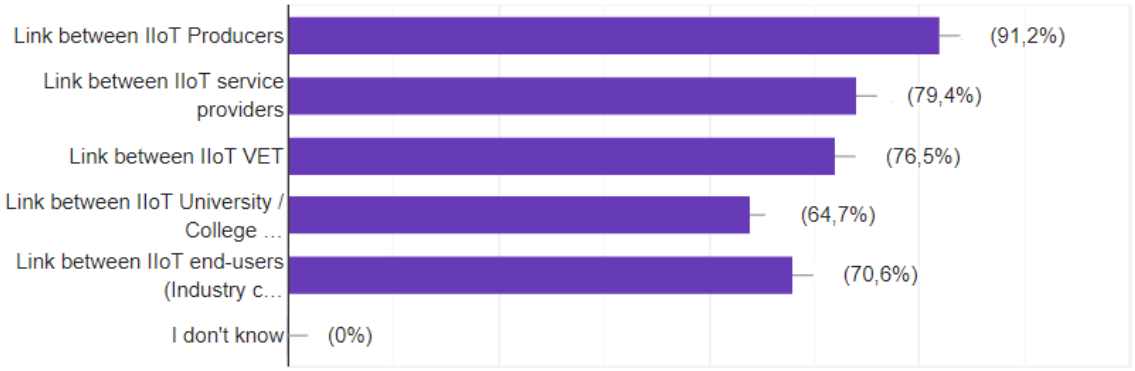
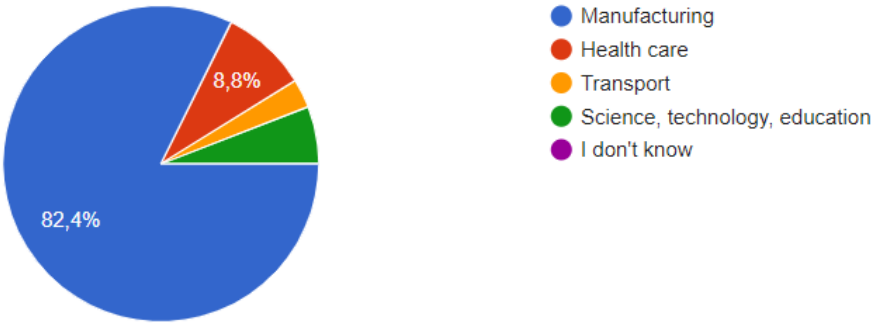
40. Please select the core functions of the IIoT Network that we envisage to establish (multiple selection possible):



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

42. From the main 4 focused Industries, which one will generate the biggest amount of data (multiple selection possible)



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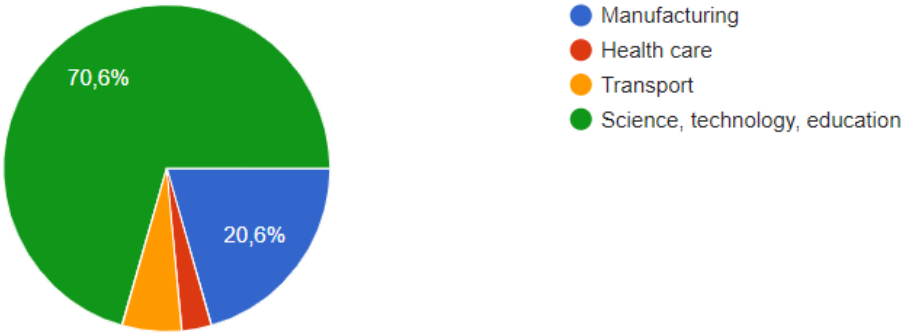
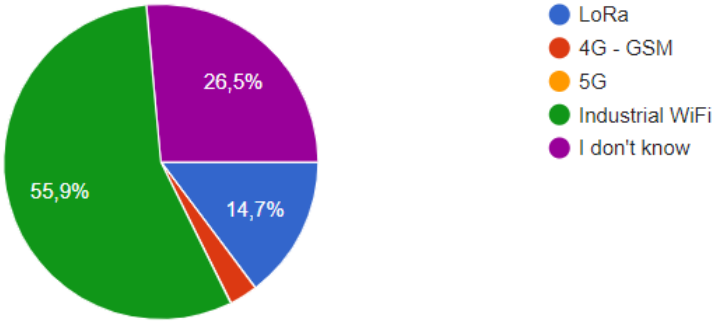
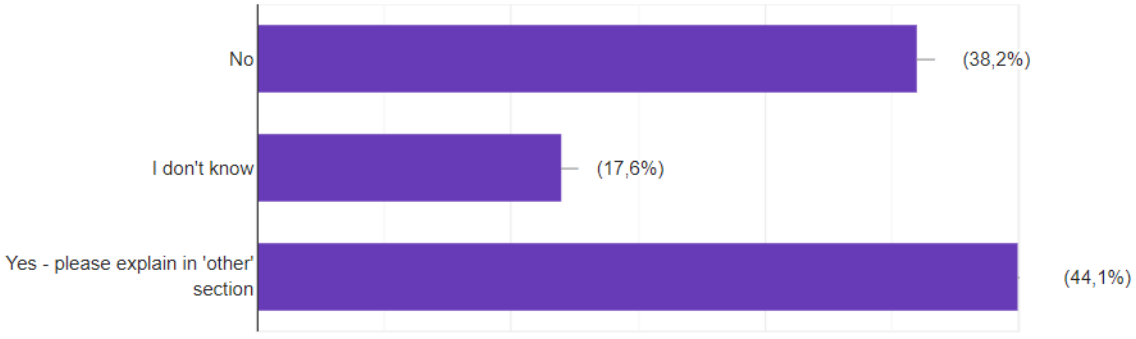
43. Which industry will generate new data with biggest frequency



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



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



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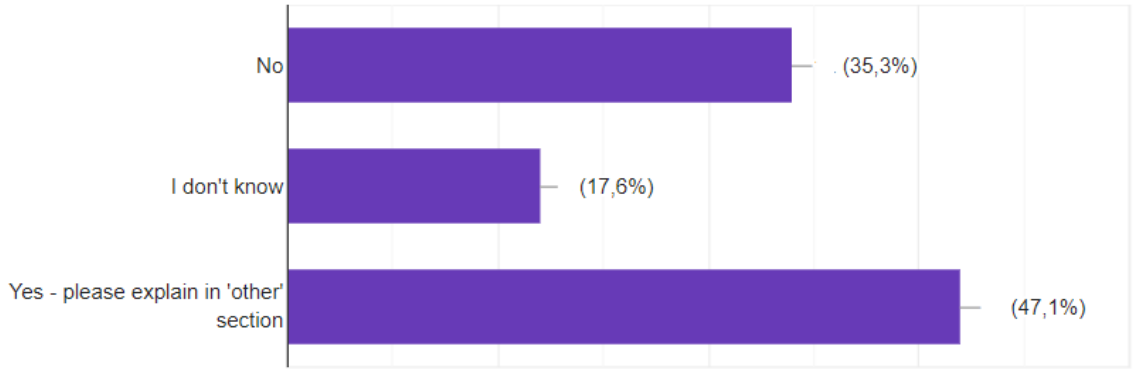
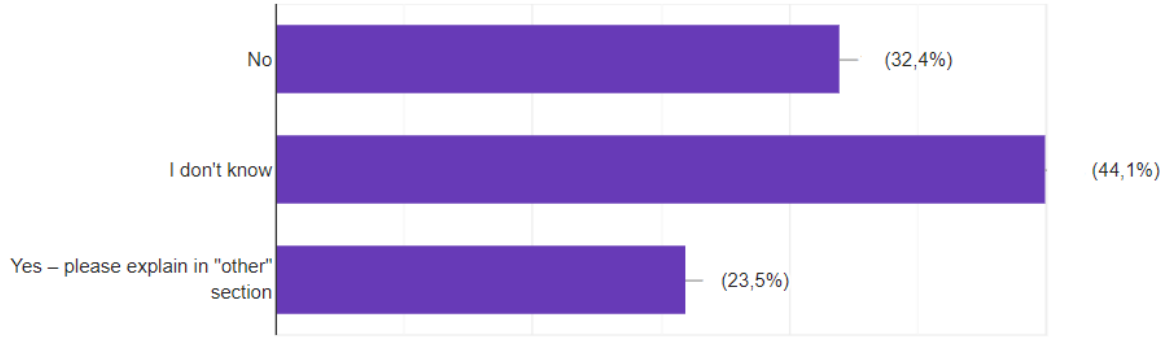
46. Do you expect to use a special methodology for collection of data from IIoT devices



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



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