DIGINNO
Digital Innovation Network

EUSBSR
EU STRATEGY
FOR THE BALTIC
SEA REGION
POLICY AREA 'INNOVATION'

Interreg
Baltic Sea Region

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DIGINNO BUSINESS NEEDS ASSESSMENT

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Executive Summary

The overall aim of the DIGINNO project is to speed up the Baltic Sea Region's (BSR) transition to a single digital market. More specifically three challenges are addressed: 1) uptake of information and communication technologies in the business sector; 2) innovation and interoperability of public services; and 3) cooperation and coordination of digital policies on the macro-regional level. The purpose of the Business Needs Assessment (BNA) is to give an overview of the State-of- the Art of challenge 1) and provide input for challenge 3).

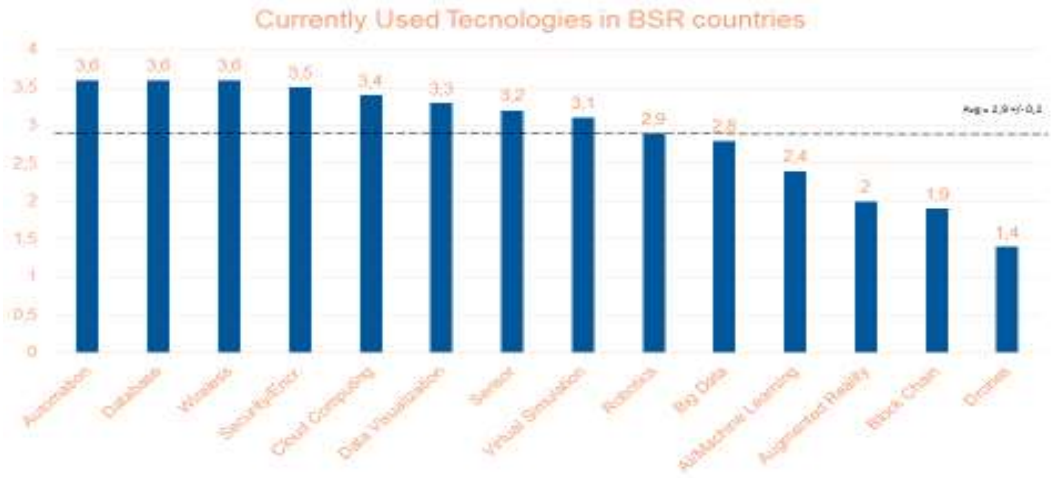
The BNA was performed with the following steps:

- Identification of key technologies influencing the current digital disruption.
- Selection of representative and important industries in the participating countries for the BNA.
- A quantitative analysis of usage of the key technologies. The analysis is based on questionnaires rating the current and expected usage, in a five years perspective, of the different key technologies
- A corresponding qualitative analysis of usage of the key technologies based on interviews.

The analyses would reveal which of the investigated technologies were actually used in the selected industries representing key activities in DIGINNO partner countries. The assumption being that the analysis gives an indication of the usage of key digital technologies in the region and in the individual countries.

Generally, the currently used technologies are rated similarly with respect to importance in the countries as shown in the figure below.

Currently Used Technologies



Looking at the countries by combining insights from the quantitative and qualitative data there seems to be a trend showing that Denmark, Finland and Sweden are more advanced in the usage of ICT than the other countries. This insight is highlighted in the country overview section of the report.

Looking at the expected importance of technologies, the pattern is almost as for the current technologies with the difference that the importance of all technologies is expected to be higher in the future (See Fig. III.2 in Section III in this report) – this goes generally for all the countries.

Some common problems on the impeding take up of digital technologies – most manifest in the Baltic countries – are identified in the report

- Access to workforce/shortage of labor force.
- Need for upgrade of infrastructure
- Need for upgrade of networking
- Regulation
- Lack of financial instruments
- Taxation – this is, however, seen as general economic policy and outside the scope of the project

As a response two sets of recommendations are formulated

1) for further project actions
2) for policy actions

Re 1) a project activity that further shall validate the survey results and specifically clarify identified problems associated with upgrade of infrastructure; upgrade of networking; regulation; financial instruments and ultimately strengthen the suggested general policy actions.

Re 2) a potential in BSR collaboration is identified within the areas of, e.g.

- The identification of drivers to realize the expected higher penetration of already deployed ICTs;
- The identification of potentials for deploying low rated ICTs ;
- The need for education programs to realize the above;
- And the need for awareness raising – to realize the three bullets above.

Section 1 Introduction

The overall aim of the DIGINNO project is to speed up the Baltic Sea Region's (BSR) transition to a single digital market. More specifically this is done by addressing three challenges: 1) uptake of information and communication technologies in the business sector; 2) innovation and interoperability of public services; and 3) cooperation and coordination of digital policies on the macro-regional level. The purpose of the Business Needs Assessment is to give an overview of the State-of- the Art of challenge 1) and provide input for challenge 3).

This report documents and discusses the results of a Business Needs Assessment (BNA) in the DIGINNO partner countries: Denmark; Estonia; Finland; Latvia; Lithuania; Poland and Sweden. The idea of the BNA is to describe three aspects of the IT-situation in the partner countries: 1) the awareness of selected digital technologies and the current take-up; 2) the expected future take-up; and 3) the perceived conditions for the take-up (drivers/ barriers).

Knowledge of the IT-situation in the BSR is needed as we are in the middle of a paradigm shift where new digital technologies disrupt and potentially destroy existing business areas and create new ones with different qualities.

An example is car navigation systems that disrupted maps, gave additional value to drivers via instructions where to go by voice commands. This disruption was enabled by advancement in small computers; voice synthesizer technology, electronic maps and GPS satellite systems that together made it possible enabled car navigation systems for the mass market.

Later these car navigators were disrupted by navigation apps for existing and future smart phones, which saved the navigator hard ware and included seamless updating of electronic maps.

These example illustrate two features of 'manufacturing 4.0', 1) disruption is an ongoing process; 2) the disrupting digital technology involves and requires several new digital competences (e.g. Sensor Technology, Wireless technology, Security, Automation technology, Robots, Drones, Big Data and Machine Learning etc.), which are not necessarily available for a company at a given time in a given location. Further companies may not be aware that adopting these digital technologies may be necessary to stay in a given market.

The *Business Needs Assessment (BNA)* aims at describing the awareness of these technologies; the current and future take-up; and the perceived conditions for the take-up (drivers/ barriers) in the DIGINNO partner countries.

Section II Methodology

The BNA was performed with the following steps

- Identification of key technologies in the digital disruption.
- Selection of industries for the BNA.
- A quantitative analysis based on questionnaires
- A qualitative analysis based on interviews.

II.1 Key Technologies

The selection of key technologies for the BNA was inspired by Accenture's characterization of the disruption process, Fig II.1 (https://hbr.org/2018/01/how-likely-is-your-industry-to-be-disrupted-this-2x2-matrix-will-tell-you; accessed 12.03.2018).

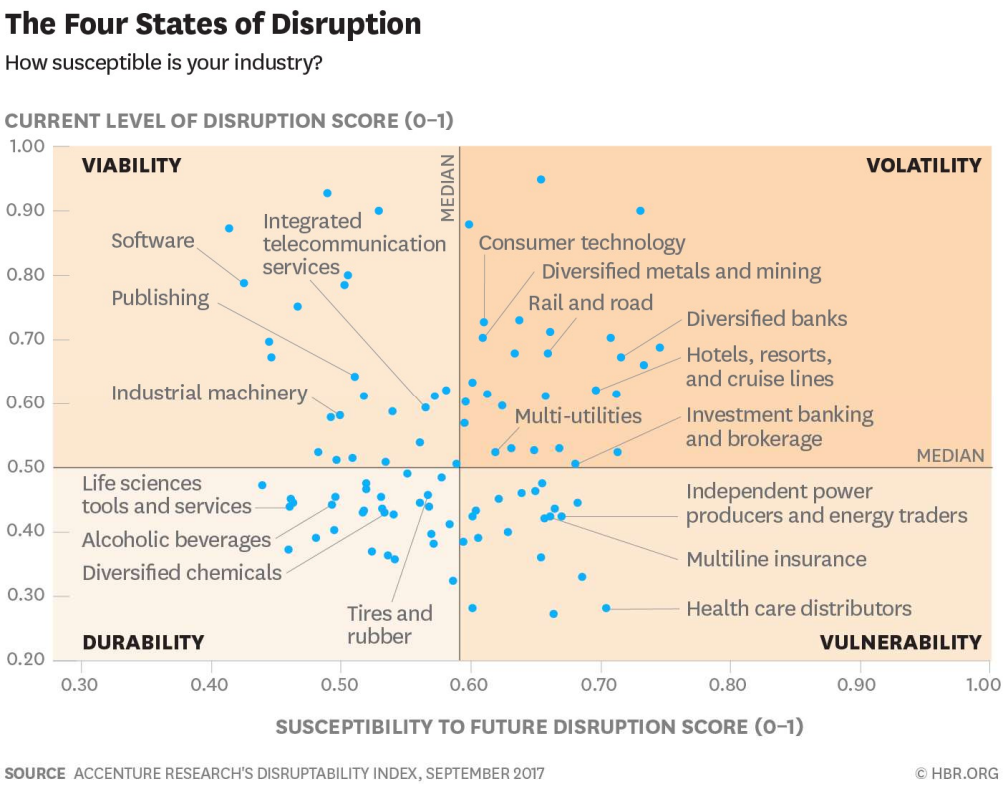


Figure.II.1. The four states of disruption

In the figure, Accenture constructs disruptive indices by plotting industries in a coordinate system with an X-axis where S*usceptibility to future disruption* is scored (0-1) by examining the presence and market penetration of disruptor companies and considering incumbents' financial performance. Along the Y-axis, the *Current level* of *Disruption* is scored (0-1)*;* here they

measured incumbents' operational efficiency, commitment to innovation, and defenses against attack are measured.

Following discussions inspired by the disruption 'mechanics' in Fig. II.1 a number of digital technologies were identified by DIGINNO WP2 partners as potential key factors in development of industry in the BSR:

- Sensor technologies
- Wireless technologies
- Automation technologies
- Database (Data Acquiring) technologies
- Big data/analytics
- Machine Learning/AI
- Augmented Reality /Virtual Reality/Mixed Reality
- Cloud computing
- Block chain
- Security/encryption
- Data visualization
- Virtualization/simulation
- Robotics
- Drones

These technologies are briefly characterized and described in Appendix 1. These technologies were adopted as those to be investigated based on the parameters defined in the BNA.

II.2 Selection of Industries/Sectors

The idea was that each project partner perform an analyses of the current awareness; importance and expected future impact of these technologies in *manufacturing* (common for all) and in two sectors selected as specifically relevant for each country.

The relevance should be decided from the following criteria namely, the growth potential; DIGINNO area relevance, i.e. strength/ competitiveness; mobility relevance; Local business needs; the country's strength in the sector/ the country's weakness in the sector.

Ideally, each partner should then rate the importance of the criteria on a scale 1 to 5 in each potential sector and based on this, select sectors for the country BNA. This was not done/ reported systematically from all partners; however, the methodology process proposed by and utilized at CMI/ AAU for Denmark is shown in Table II.1, resulting in selection of Health Care and Finance, Insurance Banking as the two individual sectors (marked in blue) for the Danish analyses.

Table II.1 Selection of sectors for the BNA in Denmark

Criterias / Sectors	Energy	Transport	e-Commerce Supermarkets Grocery stores	Finance: Insurance Banking	Automobile	Manufacturing	Health Care	Agriculture	ICT Sector
Growth scenarios	5*	4o	4#	5£	5+	5%	5+	3$	5+
BSR relevance	?	?	?	?	?	?	?	?	?
Digitialization/Industry 4 and IoT	4	4	5	5	5	5	5	4	5
New future business areas	3	4	4	5	4	4	5	4	4
BSR competitive to rest of the world	4	4	3	4	2	3	4	4	4
Mobility relevance	2	2	3	5	3	3	5	1	4
Business needs	5	4	4	5	4	5	5	4	5
Implementable / Potential	4	4	3	4	4	5	4	4	5
Your country's strength in the sector	5	4	4	4		4	4	5	5
Your country's weakness in the sector					4				
Score: 1 (low) to 5 (high)				Individual sector choice		Common sector choice	Individual sector choice		

Sources:

* http://ec.europa.eu/eurostat/statistics-explained/index.php/Renewable_energy_statistics
+ https://ec.europa.eu/growth/sectors_en
O https://ec.europa.eu/growth/sectors_en
£ https://www.ebf.eu/competitiveness-of-european-banks/
$ http://capreform.eu/what-is-the-growth-potential-of-eu-agriculture/
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Within the sectors, the DIGINNO partners agreed that it generally is relevant for the analysis to distinguish between actors with different potential roles in the disruption process.

- Operators
- Enablers
- Creators

Operators
Companies using the ICT technologies to transform own physical products or for improving the production process. In Denmark, examples are Føtex, Mærsk Line, Roskilde Festival, ARLA, Coloplast, and Copenhagen Municipality

Enablers
Companies enabling ICT solutions by providing the backbone infrastructure or by selling knowledge about the technology. Examples are tele and network providers or consultancy companies as TDC, Telia, Microsoft (Azure), IBM (Watson Blue Mix), Amazon and others.

Creators
Companies developing the technical ICT solutions or components, sensors, communication technologies, IoT platforms etc. Company examples Danfoss, Philips Hue, Cryptera, Arrow, and CMI.

The companies investigated in this study were operators. This was because partners had access to mostly operators.

II.3 Quantitative Analysis

A questionnaire was developed to identify the current level of digitalization; the current and future relative importance of the technologies listed in section II.2 above; the expected/ likely disruption and its consequences and the perceived general business environment (Appendix 2); in most countries it was translated to the local language by partners and reported in English). The questionnaire including a short explanation of the technologies (Appendix 1) was sent to approx. 150 companies in each partner country and 10- 20% response were received.

The respondents were asked to give a rating on a scale from 1 to 5 of their answers to 10 questions related to the technologies:

- What is the level of digitalization in your business
- Which of the following digital technologies (DT1 to DT14, Appendix 1) do you use in your business today?
- Which of the following digital technologies (DT1 to DT14 in Appendix 1) do you think you will use in your business in 5 (five) years?
- To which degree do you think that new business possibilities will replace your existing ones?
- To which degree do you think that competition will increase/decrease in your business area due to digitalization?
- How likely is it that you will get new customers in other EU countries to your new digital business?
- How likely is it that there will be new partners in the implementation of new digital solutions in your businesses?
- Where will you position the new digital possibilities in your business area as a driver on a scale from 1:‘Supporting existing business’ to 5:‘Creating new business areas’?
- How much will digitalization affect your business in 2 years? From 1 (not at all) to 5 (very much)?

- How supportive is the overall business environment for digitalization of companies in your country and in your business sector?

The responses were analyzed by CMI/ AAU with the aim to give an overall characterization of the awareness of ICT; the usage; expected usage and environment for uptake in each country including an estimate of the margin of error on the quantitative results assuming a statistical normal distribution of answers. This assumption is not tested; there seems to be a methodological uncertainty of the 5 points scale; when respondents are not so sure they tend to give middle score to the questions.

Strictly speaking, the results reflect the opinions and evaluations of the respondents in each country, but the results were validated by experts from each partner country to achieve a more general picture.

II.4 Qualitative Analysis

To supplement the quantitative analysis interviews were performed with 10- 20 companies in each country with the same overall aim as the survey described in II.3. A common interview guide was agreed upon; it was understood as a 'check-guide', not to be read out. (Appendix 3). The interviews were performed in the local languages and reported in English by the partners. The answers were analyzed by CMI/ AAU and are discussed for each country below.

Section III The IT- situation in the Partner Countries

III.1 Currently Used Technologies

Looking at the overall quantitative results some patterns emerge – remembering that it is based on responses to the DIGINNO surveys, not comprehensive national surveys. However, national experts have validated the results as giving fair impressions of the situation in the countries.

Generally, the currently used technologies are rated similarly with respect to importance in the countries: Automation; Databases; Wireless; Security/ Encryption; Cloud Computing; Data Visualization; Sensors; Virtual Simulation; are above the average importance rating of 2.9 on the 5 step scale. These are technologies supplied by enablers such as IBM on platforms. Hence, operators are able to subscribe to the technology to deliver their services without having to develop their hardware or software. In this manner, the cost of production and service delivery is lower for the operator. This advantage enables the operator to combine these technologies, either independently or via partnerships, to provide technical solutions to different vertical sectors of the economy. Therefore, the operators have identified the value and the marketing channel possibility for these technologies.

However, other technologies such as Robotics; Big Data; AI/ Machine Learning; Augmented Reality; Block Chains; Drones and especially the four last are on/ below the average (Figure III.1). The reason for the low adoption of these technologies is lack of perceived value resulting from: high cost of deployment; absence of clear revenue streams; and fewer use case scenarios for the utilization of the technology. The low adoption of Big Data, AI/Machine Learning, Augmented Reality and Block Chains is resulting from the lack of perceived value of this technology to products, and deficiency of service development processes by the majority of operators. The low adoption of Block Chains is also a result of the high costs of deployment. For drone-based services, there is a lack of clear revenue streams. Furthermore, most operators cannot conceive use cases in which drones can support their production and service delivery processes.

From a BSR perspective, a common trend is that operators generally are clear about the potentials and the value of these technologies to their services. It is also a common trend that operators have clear strategies on how to utilize the technology, competences and resources from complementary and competing partners to deliver their services. Furthermore, another common trend is that operators have identified relevant production and service delivery partners outside the EU and the BSR.

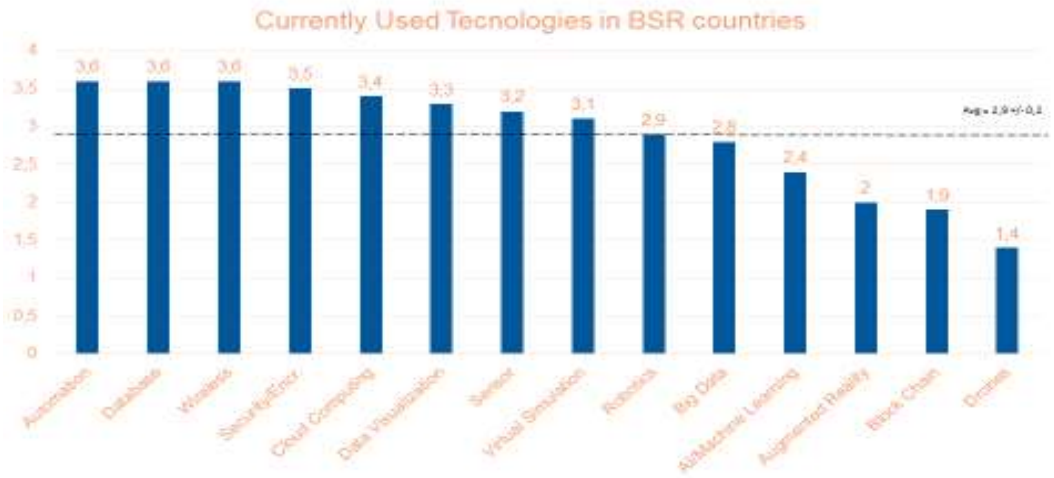

Figure III.1 Currently Used Technologies

However, looking at the countries and combining quantitative and qualitative data there seems to be a trend showing that Denmark, Finland and Sweden are more advanced in the usage of digital technologies than the other countries.

As we have 140 answers for the partner countries, the margin of error is less (+/- 8%) than for the quantitative results for the individual countries.

III.2 Importance of Technologies in Five Years

Looking at the expected importance of technologies, the pattern is almost as for the current technologies with the difference that the importance of all technologies is expected to be higher (Fig. III.2) – this goes generally for all the countries.

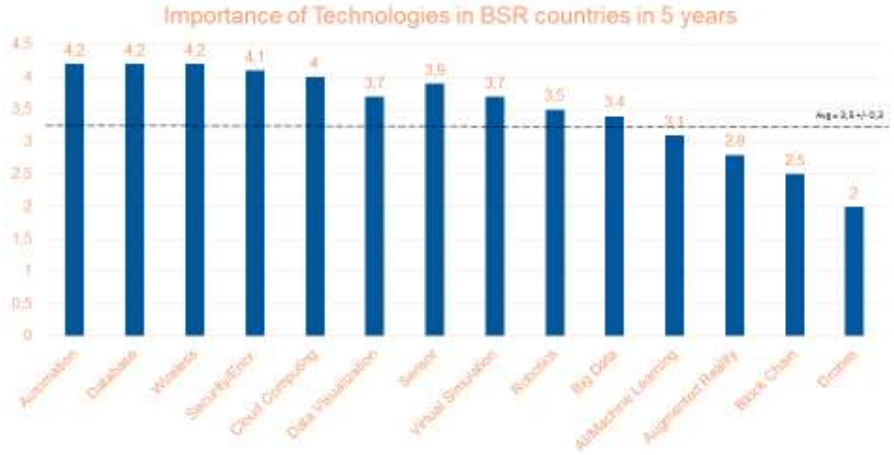

Figure III.2 Importance of Technologies in Five Years

The operators interviewed, did not foresee much of a digital disruption in the next 5 years. However, these projections were not a result of a nonchalant attitude to the future. Rather it was cautious optimism that things will remain the same; hence, there is a positive approach towards the adoption of more of Automation, Databases, Wireless, Security/encryption, Cloud Computing, Data Visualization, sensors, virtual simulation, Robotics and Big Data. However, AI/machine learning, Augmented Reality, Block Chain and Drones are technologies that will be used to a lesser extent in the BSR as seen in figure III.2.

III. 3 Impact of the General Environment

In the analysis of the answers provided by the respondents in the qualitative interview, three areas stand out as important issues in the general environment. These are Taxation; Upgrade of the infrastructure; Competence development including networks and education.

It is generally stated that taxes, including VAT on the procurement of the technologies, are cumulatively high for some operators with low budget and small market size.

The need for upgrade of infrastructure refers to the ability to facilitate the scalability in production due to infrastructure constraint. The inability to facilitate infrastructure upgrade is due to inadequacy of resources. However, the potential market for certain products needing upgraded infrastructure is growing. Examples include the growing demand for smart home products, assisted living products, autonomous systems etc. Hence, the inability of the operators to upgrade their infrastructure will result in small-scale production and it may hamper the growth of the operators in the BSR.

The lack of competence is a problem that was common in all countries surveyed. It is evident that in the BSR, more human resources with competences within the digital technologies are needed. These competences are needed to create the avenue for new innovation as well as expand current activities.

In the quantitative survey, the lack of IT infrastructure, the lack of physical infrastructure to support the operators and awareness and low level of networking activities were identified as the most common challenges.

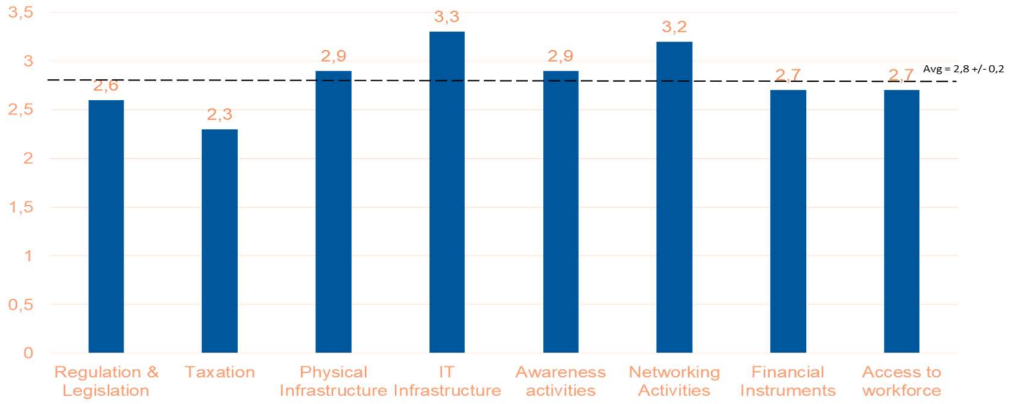

Figure III.3 Factors affecting the general environment.

Section IV Selected Country Overview

In this section, the qualitative and quantitative data from industry respondents in Denmark, Lithuania, Finland, Sweden, Latvia, Estonia and Poland are analyzed. In some countries, industry respondents did not respond to all sub questions. In the case of Finland, the qualitative responses were in a slightly different setting where feedback was aimed directly at validating the quantitative survey. As mentioned in Sect. II.3 a margin of error for the quantitative results is estimated based on the number of responses.

IV1. Denmark

IV.1.1 Quantitative survey

The following figures and table present the data from the quantitative survey, where we have received valid responses from 30 companies. The ratings are based on 5-point rating scale where 1 is the lowest and 5 is the highest rating; The margin of error $\sim 1/\sqrt{n} = 1/\sqrt{30} =$ **+/- 18 %** which has to be taken in account for the numerical results below.

IV.1.1.1. Critical Technologies of Today

Figure IV.1 depicts the ratings concerning different technologies used in the Danish companies today. As seen the Danish companies are highly advanced when it comes to the use of digital technologies. The only technologies that have low ratings are *Drones* and *Block Chain*. The technologies like *Sensors, Wireless, Automation, Databases, Big Data / Analytics, Cloud Computing* and *Security/encryption* are used intensively in the companies. Just below these technologies, we see *Machine Learning/AI, Data Visualization, Virtualization/simulation* and *robotics*.

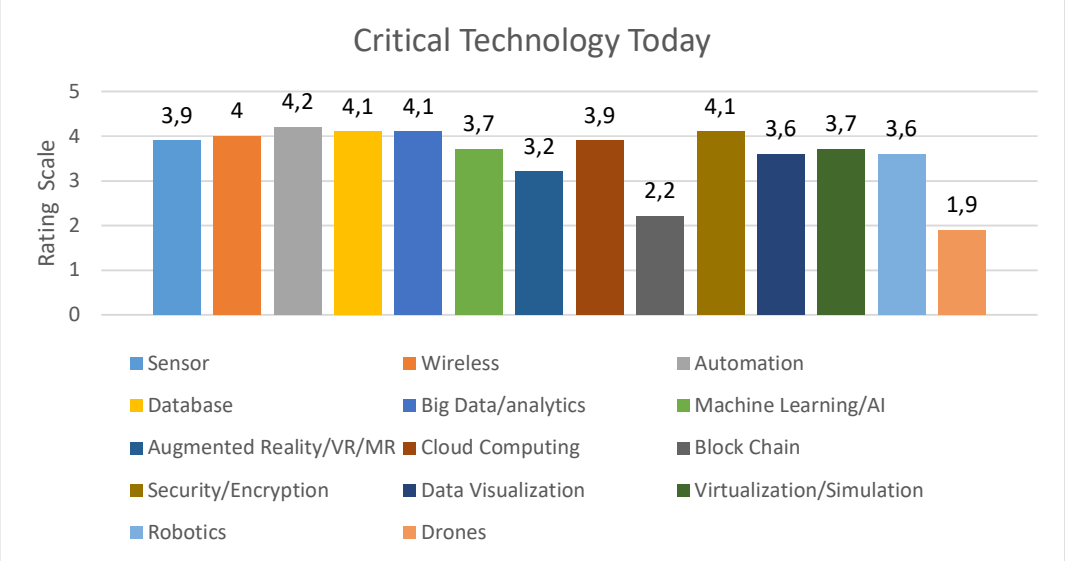

Figure IV.1 Current Critical Technologies in Denmark

IV.1.1.2. Critical Technologies in 5 years

Figure IV.2 depicts the ratings of different technologies that is foreseen to be used in the Danish companies in the next 5 years. The forecast from the respondents is that use of digital technologies continue to be at a very advanced level in the Danish companies in the next five years. The use of technologies like *Block Chain* and *Drones,* which are not used so much today, are foreseen to be on the lower side also in the future. The latter is partly due to the fact that *Drones and Block Chain* have specific applications and we have not had many companies with products, services or processes that will be affected by these technologies amongst our respondents.

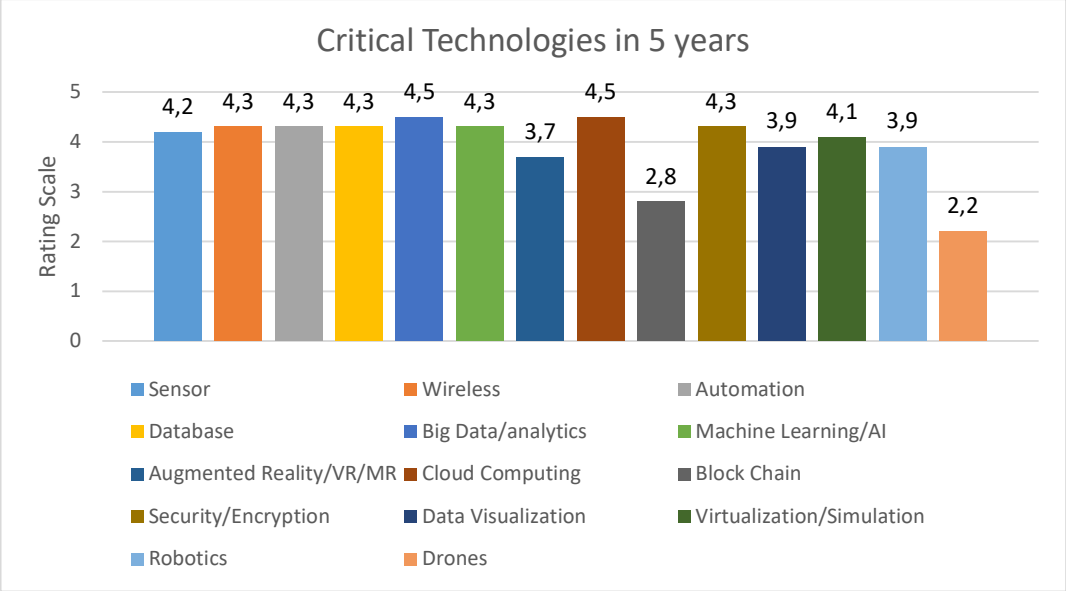

Figure IV.2 Future Critical Technologies in Denmark

IV.1.1.3. Business Environment

Concerning the business environment and the kind of support, the companies require from the state, industry associations, partners and other organizations to implement new digital solutions into their business a number of issues were raised. The issues and the ratings are illustrated in figure IV.3. As seen in the figure *IT infrastructures* and *Networking activities* receive highest ratings and are seen highly important by the companies. These are followed by *Physical Infrastructures* and *Awareness activities* as second most important parameters. On the third place we see *Regulation and legislation, Financial instruments* and *Access to workforce* that are seen as important as enablers for the use of digital technologies. Lastly, taxation is suggested as a parameter that will have less influence of the process of digitalization of Danish companies.

Recently there is a hot debate in Denmark with respect to *access to qualified workforce.* Due to the size of country, the question is to what extent the workforce needed can be obtained within the country or we need to go abroad and attract the workforce with right skills in other European countries or from international markets. The issue is directly related to the foreign policy and the question of open or close boarders that is the central issue in the debates.

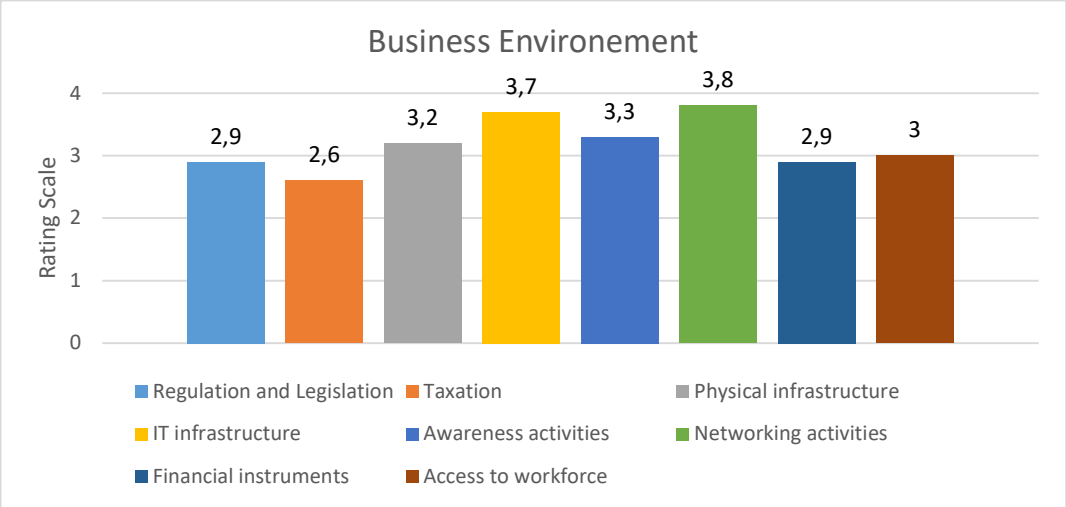

Figure IV.3 Current Business Environment in Denmark

IV.1.1.4. Competition and Partners

Table IV.1 lists the attitude of the respondents towards a number of quantitative questions that illustrates the competition situation and the partners due to digitalization. As seen in the table there is high expectations amongst the respondents that the companies *get new customers in other EU countries*, there will be *new partners in the implementation of new digital solutions*, and *new digital possibilities support companies' existing businesses or create new business areas*.

On a lower expectation level, it is obvious that the Danish companies foresee that the *competition will increase due to digitalization, digitalization will affect the businesses in 2 years* and that *new businesses replace existing ones.*

Table IV.1 Competition and Partners

Question	**Rating**
Will new business replace existing ones?	3,4
How much will competition increase/decrease due to digitalization	3,6
Will you get new customers in other EU countries?	4,0
Will there be new partners in the implementation of new digital solutions?	4,2
Will new digital possibilities support your existing businesses or create new business areas?	4,3
How much will digitalization affect your business in 2 years?	3,7

IV.1.2. Qualitative Survey

1. Which digital technologies (DT1 to DT14, Appendix 1) do you use today in your business, and how would you evaluate your company's ability and readiness to leverage digitalization in comparison with your (current and future) partners, customers and competitors?

Three of the four Danish respondents interviewed were users of all the technologies. However, their level of usage varies for product and service development as will be explained in the next section. The fourth respondent is a knowledge based SME, hence they have not adopted the new technologies mentioned in the report. However, they use other digital solutions.

What are your strongest areas?

Three of the four Danish SMEs interviewed are strong in the vertical utilization of most of these technologies. They utilize and combine the technologies to deliver vertical services such that healthcare and other sectoral services. There is a great utilization of sensor-based technologies and very little utilization of drones and Blockchain. However, in the horizontal utilization of these technologies, the Danish companies interviewed are strong in the use of the following technologies. Sensors, automation, databases, cloud computing, security encryption and data visualization. Wireless, Big data/analytics, machine learning/AI, Augmented reality, virtualization/simulation, and robotics are utilized as support technologies for specific services as required by the client.

How do plan to improve your competitiveness in digitalization?

A respondent providing innovative welfare technology has positioned the company to develop their product and services by drawing competences from different skill set. The company has decided not to compete on the basis of technical skills because Global companies already possess these skills. Hence, it was important to create leverage based on the weaknesses of global competitors who are too "techy". This respondent and another respondent improve their competitiveness by outsourcing some of their production process in order to optimize their production and save cost. Another respondent, a service provider involved in tele-health, plans to become competitive by further specialization in the type of service they provide. They aim at being unique and standing out as a brand name for tele-health products and services. Another respondent is also improving competitiveness via outsourcing some of his or her production processes. However, they are also serving as a platform gateway by providing open access platforms to their competitors. The fourth respondent is planning to adopt sensor-based technology for managing customers.

2. Do you have a digital strategy and/or an operational plan for its implementation and what is the period? Please provide a short definition of your digital strategy.

Three of the four companies interviewed possess digital strategies. These respondents possess a written digital strategy for external product oriented strategy and an implied internal strategy guiding the internal development strategy. The fourth company does not possess a strategy because they are not producing digital products.

How could digital disruption scenarios look in your business?

Two of the respondents actually see their business as being disruptive to their ecosystems. However, one of the four companies indicated that disruption is unpredictable. However, based on the emerging trend in their ecosystem, the respondent was able to predict that more or platform based services are emerging. Hence, the respondent, though unable to predict the future, had some forecast based on emerging trend.

What would be your company's role and target position?

The respondent that envisaged the growth in platform-based services is poised to be a part of the platform revolution. The respondent identified the need for acquisition of human resources with the requisite skills. For another respondent the plan is to forge more partnerships and collaborate more on product and service development with external partners.

3. Could you implement digital solutions by yourself in your organization or do you need help from other companies/partners in a cross-sectoral collaboration, especially with ICT?

None of the respondent apart from the knowledge institution developed products and services independently. They collaborate with external partners in the development of products and services.

Have you established any such (new) contacts or relations?

The respondents work with International partners in Asia, Europe and the United States. They are also working in collaboration with Universities in Denmark and industry clusters such as the welfare tech.

4. Which digital disciplines do you need in your business to implement your digital strategy?

Skill in the 14 technologies are identified as needs in Denmark. This is because the SMEs are constantly combining these technologies to develop new services. However, the skills and competences needed is lacking in Denmark as well. One of the respondents called for a special focus on IOT in technical schools and universities. However, one of the respondents mentioned that the finance to hire persons with these competences could be problematic. As a result, they prefer to outsource.

5. Which of your products/services are, to some extent, based on the current state of digital technology. How many products/services in percentage?

Aside the knowledge based SME, 100% of their products are digital products.

6. Have you activated or started any plan or activities for your organization to acquire digital awareness or knowledge?

None of the respondents had a plan for creating digital awareness in their companies. This is because the SMEs interviewed had an average of 11 staff. A small percentage of the staff were technical staff while the rest were not. The technical staff had domain specific knowledge.

However, one of the interviewees has decided to think of the possibility of creating digital awareness in the company.

What kind of support would you require from the state, industry associations, partners and other organizations to implement new digital solutions into your business?

For one of the respondent, they do not need support as they are scaling up. Another needed support with respect to the focus of the education system on IOT related courses. Another respondent indicated that the company needs all the help that is available. This is help in both public support, competence development, collaboration with industry and educational institution.

IV.1.3. Summary

The Danish companies who provided feedback on the quantitative survey are advanced in the adoption of digital technologies. They expect to continue using these technologies in the next 5 years. However, they expect some support in their networking activities and the availability of the necessary IT infrastructure to support their operations. In order to remain competitive, they are looking forward to expanding their market in the EU as well as collaborate with relevant business partners to develop new solutions. Tax, regulations and financial instruments are the challenges faced in Denmark.

Insights from the qualitative study indicates that Danish companies are advanced in the adoption of digital technologies. Although the sample size for the interview was small, they highlighted three classes of SMEs in Denmark. These are platform providers, knowledge based SMEs and sector based IT technology service providers. Some of these SMEs are quite small but they are developing innovative solutions in the vertical sectors using most of the technologies identified. They work in great collaboration with public authorities and with their competitors in the industry to leverage competences to develop these innovative solutions.

Although the Danish SMEs are quite advanced, there is the great need for competences and greater collaboration.

IV.2 Lithuania

IV.2.1 Quantitative survey

Following figures and table present the data from the quantitative investigation, where we have received valid responses to the survey from 10 Lithuanian companies. This results in a margin of error $\sim 1/\sqrt{n} = 1/\sqrt{10}$ = **+/- 32 %** which has to be taken in account for the numerical results below.

IV.2.1.1 Critical Technologies of Today

Figure IV.4 depicts the ratings concerning different technologies used in the Lithuanian companies today.

As seen, the scores are highest for Databases, Cloud Computing, *Wireless, Security and encryption*. At the second level, we see *Sensors, Automation, Big data/analytics, Data visualization and Visualization/simulation technologies.*

Drones and *Block chain, Machine Learning /AI* and *Augmented reality/VR/MR* scored the lowest.

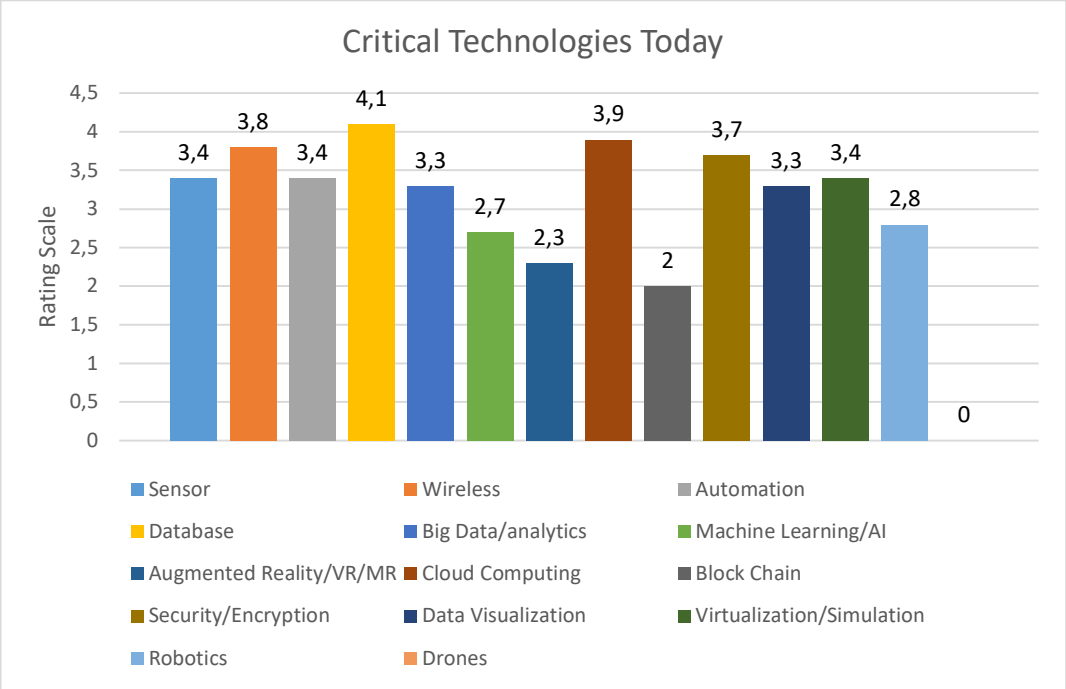

Figure IV.4 Current Critical Technologies in Lithuania

IV.2.1.2 Critical Technologies in 5 years

Figure IV.5 depicts the ratings of technologies that are foreseen to be used in the next 5 years. The forecast from the respondents is that use of digital technologies will be more advanced in Lithuanian companies in the next 5 years. *Drones* are not foreseen to be used, but all the other technologies are foreseen to be used more than the current state.

The expectation of the use of *Drones* is similar to many other countries and is due to the specificity of the technology and its applications.

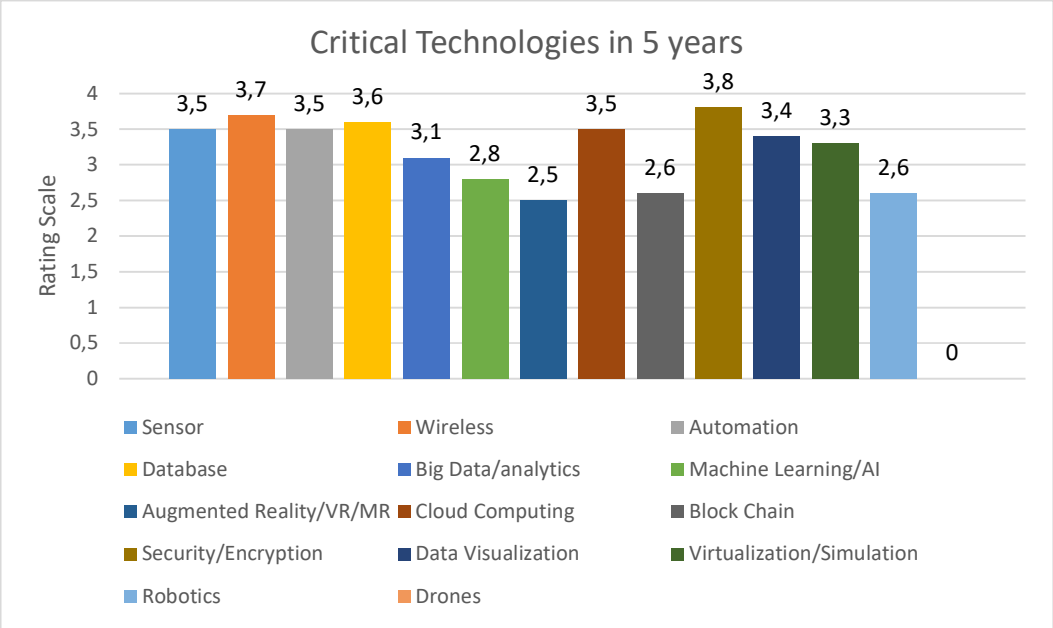

Figure IV.5. Future Critical Technologies in Lithuania

IV.2.1.3 Business environment

Concerning the business environment and the kind of support the companies require from the state, industry associations, partners and other organizations to implement new digital solutions into their business a number of issues where raised. The issues and the ratings are illustrated in figure IV.6.

As seen in the figure *IT infrastructures* highest score and are seen highly important by the companies. On the second level we see *access to qualified workforce*, *Physical infrastructures* and *Awareness and networking activities* and *as* seen *Regulation and legislation and taxation* receive less scores.

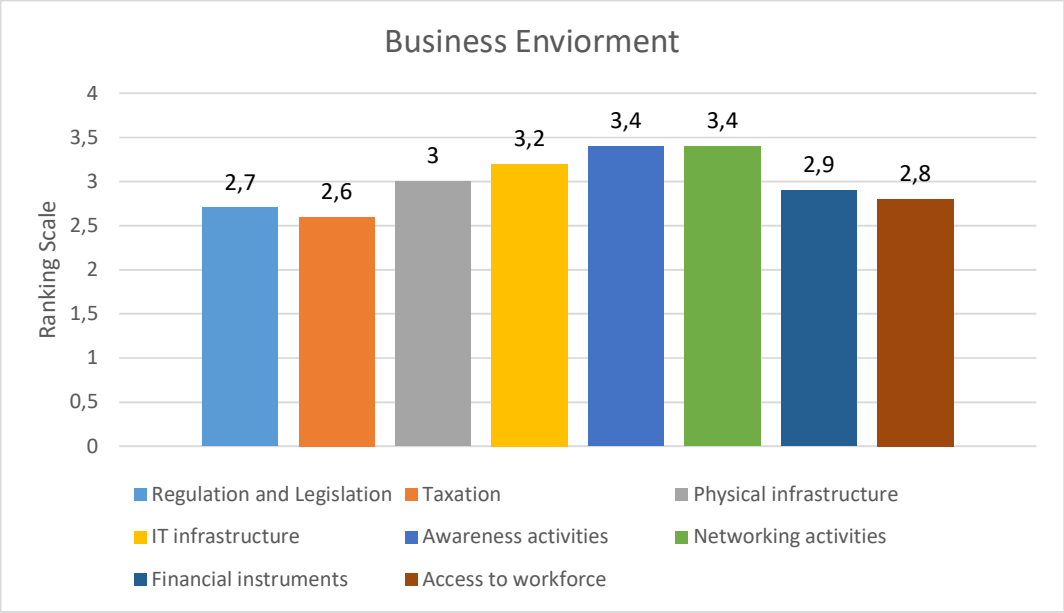

Figure IV.6 Current Business Environment in Lithuania

IV.2.1.4 Competition and Partners

Table IV.2 lists the attitude of the respondents towards a number of qualitative questions that illustrates the competition situation and the partners due to digitalization. As seen in the table IV.2 there the expectation to all parameters are at middle level. This can be due to the methodological uncertainty of 5 points scale that when respondents are not so sure they tend to give middle score to the questions.

Table IV.2 Competition and Partners

Question	**Rating**
Will new business replace existing ones?	3,0
How much will competition increase/decrease due to digitalization	3,4
Will you get new customers in other EU countries?	3,6
Will there be new partners in the implementation of new digital solutions?	3,4
Will new digital possibilities support your existing businesses or create new business areas?	2,9
How much will digitalization affect your business in 2 years?	3,0

IV.2.2 Qualitative

The quantitative investigations are based on interview with 13 representatives from Lithuanian companies.

1. Which digital technologies (DT1 to DT14, Appendix 1) do you use today in your business, and how would you evaluate your company's ability and readiness to leverage digitalization in comparison with your (current and future) partners, customers and competitors?

Figure IV.7 depicts the answers from the interviews. As seen in the figure the majority of interviewees identified wireless as the most used digital technology of today. Furthermore, more than half of them pointed to Automation, Big data analytics, databases and virtualization/simulation as the digital technologies that is used in their companies. Around than 40% identified Sensors, robotics and encryption/security and one company Machine Leaning/AI as the digital technologies the use currently. None of the companies in this interview round uses Augmented reality/VR/MR, Block Chain or Drones.

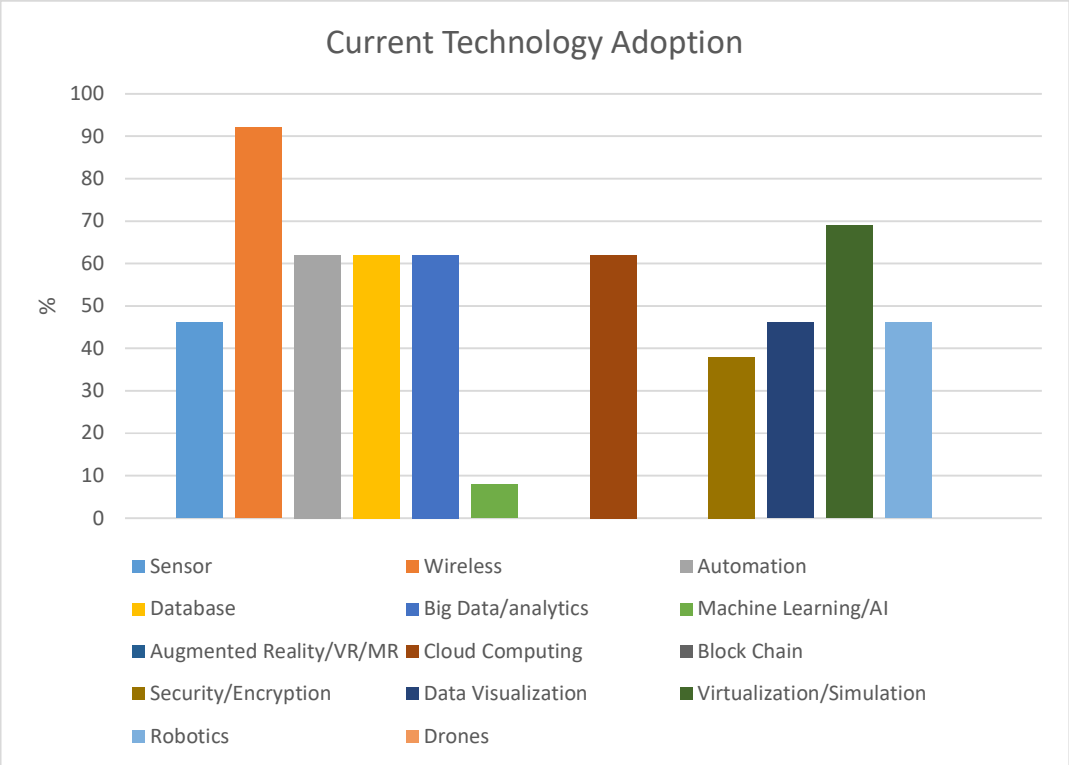

Figure IV.7 Current Digital Technology Adoption in Lithuania

What are your strongest areas (competencies, competition etc. considered?

Figure IV.8 depicts the strongest areas identified by the companies in the interviews. When it comes to the strongest areas, as seen in the following figure, answers were not received from all companies. Between 30% to 45% pint to Automation and virtualization/simulation as the strongest areas. About 20% point to sensors and cloud computing and a few companies identify

wireless, Big data/analytics, Security/encryption, data virtualization and robotics as their strongest areas.

None of the companies sees Machine Leaning/AI, Augmented reality/VR/MR, Block chain or drones as their strong sides.

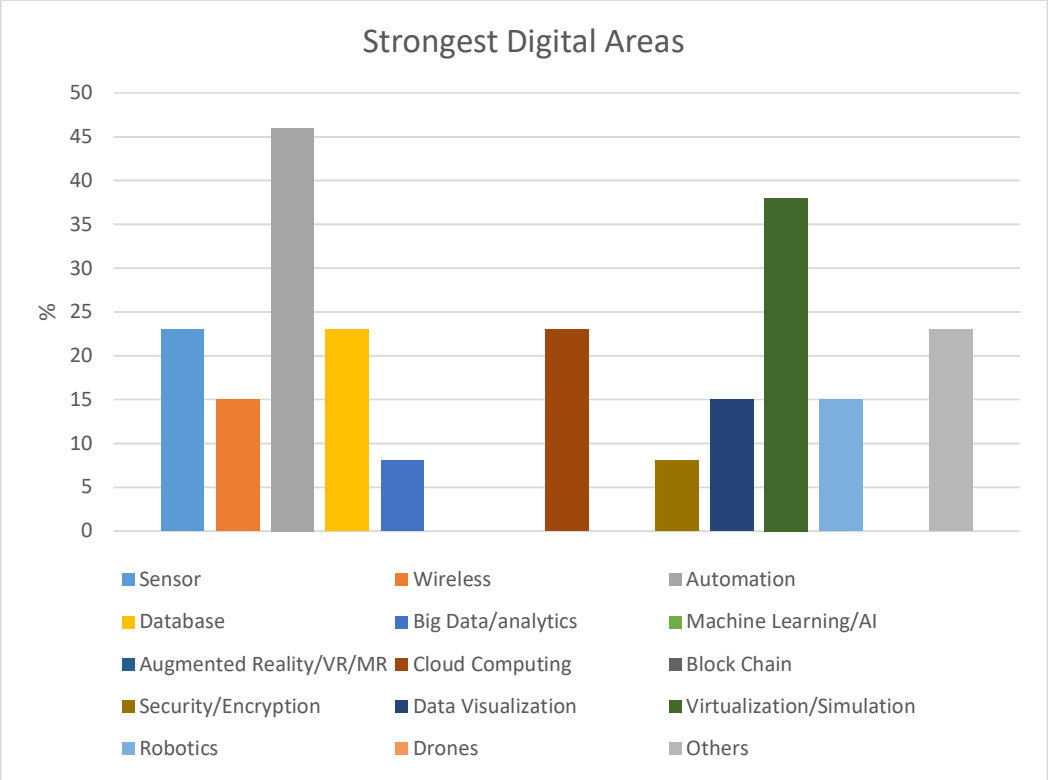

Figure IV.8 Strongest Digital Areas of the Interviewed Lithuanian companies

How do plan to improve your competitiveness in digitalization?

A number of initiatives were mentioned; amongst others, a number of interviews mentioned more focus on education, including practical courses in digitalization and more investment in digitalization. Concerning the investments, the investment in robotics and automation, effective Business Management System, more digitalized equipment were highlighted.

Other plans mentioned were a) Maximum workplace digitalization, b) step-by-step development of digital area, including expanding the IT team and IT-related project portfolio and c) new robotics systems installation.

Some organizational changes was mentioned, including horizontal integration of departments of the company, implementing new software to bring client closer to the company, going paperless to improve data reach in all facility, Process automation and digitalization, value chain adoption to meet new customer business models, effectiveness through optimization and implementation of modern production planning system and more CNC machines.

Other aspects mentioned were increasing automatic manufacturing, real-time production controlling and data collection and visualization, data transfer from papers to pc and the use of machine learning.

2. Do you have a digital strategy and/or an operational plan for its implementation and what is the period? Please provide a short definition of your digital strategy.

Mentioned here, e.g., focus on education and upgrade of digital competencies, more investment in digital technologies and automation and the organizational changes that are necessary to deploy digitalization in production and other work processes.

In the following specific issues related to the strategy are dealt with.

How could digital disruption scenarios look in your business?

To the question on digital distribution scenarios, the reactions were very different; a number of companies did not have clear answers to this, by saying, we do not have any scenarios, it is an ongoing process, or we have not started to look at this, etc.

Some of the interviewees were clear about the scenarios and identified following scenarios:

- These might be new "mobility as a service" type competitors in the market.
- Automation, rapid data exchange (vertical and horizontal integration), strategic alliances etc. might lead to stronger competitors.
- Daily life activities migration to internet might shrink the need for daily mobility.
- E-vehicles and environmental requirements might change the landscape of the leading companies in the market.
- Installation of the most effective Business Management System.

What will change (due to digital disruption etc.)?

a) Implementation and maintenance costs, b) Time spent per task, human error, monitoring, analysis, c) the quality and productivity of services will increase significantly

Other reactions were the change to more use of robotics and more work from distance enabled by digitalization and the deployment of Block chain and replacement of paper-based contract by smart contract was mentioned.

More specifically, it was mentioned that the change would affect a number of areas such that:

- drawings will all be 3D,
- there will be possibility for easy prototyping, low lot production, spare parts production on site will become relevant in daily life.
- EDI (Electronic Data Interchange) become a norm among Customer-Producer-Subcontractor.
- Augmented reality assistance in individual/customized production and Autonomous driving will be on the increase.

What will stay the same (regardless of the expected disruption etc.)?

Very diversified answers was received. One reaction was that the legal requirements will stay the same and there will be a need for customization.

When it comes to the use of IT, it was emphasized that we continually will use IT and new machines, however some replacements and upgrade is needed.

Concerning the work processes it was mentioned we still need highest qualified employees and that the 'handwork' would stay the same, even we use new digital tools.

What is sure to happen (in a digitalized future…)?

The quality will increase, efficiency will increases (one worker will produce more), productivity will improve and there will be more machines. Hybrid infrastructure and paperless business will be introduced and business velocity will increase decision making speed.

A shift to Cloud and full virtualization, we will see massive automation, the adoption of robots, and autonomous assistance systems will become more and more important.

New business models will emerge and will replace Old-fashioned business models that will fade away.

What will not happen (in a digitalized future…)?

Digitalization will not reduce energy consumption and that motivation will not decrease due to digitalization.

Employees will not be less due to digitalization. Of course, the competencies must be upgraded but the claim is that we will not reduce the number of employees due to digitalization.

What changes are you afraid of?

Lack of qualified personnel and demotivation of elderly workers. On the same note, one of the interviews was concerned about the rising demand of qualified employees and the cost issues related to this.

High investment needs and unsustainable governmental decisions are amongst other concerns raised by the companies.

Companies' ability to perform in the competition. Statements like "New competitors, possessing all "know how" about product and market and able to subcontract the whole product" and "Competitors can improve artificial intelligence more quickly" underline these concerns.

Furthermore, there were concerns about data loss, lack of standardization and harmonization.

What changes do you hope for?

Increase of quality, productivity, and elimination of human error. One of the interviewees' answer to the question was 'To improve productivity and to replace most complicated and detrimental workstations'.

They hope for,

- less overheads and faster IT technology implementation and decision-making.
- a more affordable and more powerful additive manufacturing (3D printing).

What would be your company's role and target position?

Two companies indicated the 'data safety' and 'support' as their role, and yet another company stated their role would be "Main contractor to provide whole value chain for the customer: starting from idea and delivering new product".

Some other companies stated their role as "Staying ahead of market trend in Lithuania" and one company even claimed their role to be the leader of Baltic States.

3. Could you implement digital solutions by yourself in your organization or do you need help from other companies/partners in a cross-sectoral collaboration, especially with ICT?

Have you established any such (new) contacts or relations?

Out of 12 companies 8 answered yes to this question. Two companies answered no and the other two had following reactions:

- We have established new position for operating of robotics systems.
- We are starting our strategy with Lithuanian contacts.

Where are they located?

Out of nine respondents, seven are located in Lithuania (2 of them in Vilnius). The other 2 state that they are located in the EU.

Which countries and partners?

The majority of interviewees mention Lithuania. One company mentions other EU countries and specifically Turkey. Concerning partners, two interviewees mentioned Microsoft as the partner.

4. Which digital disciplines do you need in your business to implement your digital strategy?

Figure IV.9 depicts the percentage of the respondents concerning the needed digital competencies.

The majority of companies see automation, Cloud Computing, data virtualization and robotics as the important competencies for their businesses. Some companies also see digital competencies within sensors, wireless, databases, security/encryption and virtualization/simulation as important for their companies. Few companies consider Machine Learning/AI, augmented reality/AR/VR and block chain as needed digital competencies.

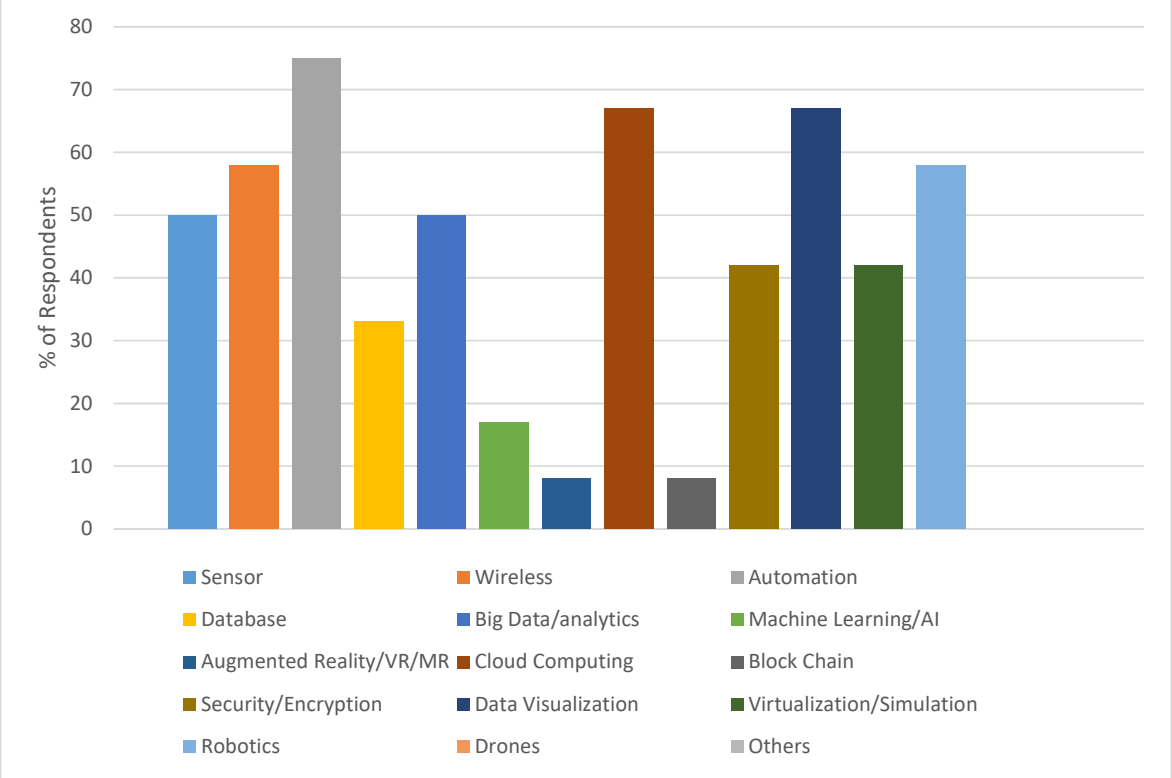

Figure IV.9 Competences required by Lithuanian Industry

5. Which of your products/services are, to some extent, based on the current state of digital technology. How many products/services in percentage?

A few companies claim that none of their products are based on digital technologies. Two companies claim respectively 10% and 30% of their products are based on digital technologies.

Other companies react by taking specific aspects from their companies such as:

- The creation of a completely new business by 3D modelling and prototyping. The solution is not yet in the market.

- Supporting their workday. In this case, digital technologies are not part of product.
- The designing of industrial equipment processes within the company.

6. Have you activated or started any plan or activities for your organization to acquire digital awareness or knowledge?

The answer to this question is no or not yet from four of the companies while others claim they have plans.

Some of the plans / activities stated by the respondents are listed as follows:

- Developing strategic goals towards the digitalization of the company.
- Getting education on 4th Industry revolution.
- The creation of a Blueprint document, with Mid-Long term strategy (digitalization in mind).
- Preparing the company according to data protection directive.
- Implementation of ERP system at a deep level.

Some companies are, however, still in the phase of gathering information and invite presentations from potential suppliers.

One interviewee is more specific and states: “Personally I attended I4.0 courses, we have also done the i4.0 audit in the company, to find the weak sides in the company”

IV.2.3 Summary

The Lithuanian respondents are generally not very advanced in the adoption of digital technologies. The average scale indicating the importance of these technologies today, for the quantitative interview was 3,2. The most adopted technologies by these companies are data driven technologies as seen in the qualitative and quantitative data. These data-driven technologies are those they will continue to use in 5 years’ time; and constitute for less than 50% of their product offerings. Based on the qualitative data, one reason for this is the lack of competent workforce. However, it also seems that these companies, based on the qualitative data are looking forward to adopting more communication technologies. This is also because they desire competence in these areas as well.

Based on the qualitative data, most of the companies do not have documented digital strategies that guide their operation. Their strategy are dynamic and market driven. Hence, it is difficult to evaluate the progress made and the potential for redefining the operational strategy in the case of digital disruption. Furthermore, organizational awareness of digital technologies is low among the respondents.

Also based on the qualitative and quantitative data, where the industry requires major support are the uncertainty caused by changing regulations, access to financial instruments and the existence of physical IT infrastructure. Access to market though not captured in the qualitative data is captured in the qualitative data. Hence, these areas, without excluding taxation issues, are areas where there is need for potential national policies. Such policies will aid in stimulating the market,

thereby allowing the companies to adopt more digital technologies. Such policies should include market driven policies, technology driven policies, competence development policies and supplemented by the organization with organizational driven policies.

IV.3 Finland

Concerning Finland the quantitative data has been validated and further qualified in a round of interviews of experts. First, the results of quantitative part are presented; then, the adjusted ratings based on the interviews are presented and discussed in the qualitative section.

IV.3.1 Quantitative data

From the quantitative investigation valid responses to the survey were received from15 companies resulting in a margin of error ~ $1/\sqrt{n} = 1/\sqrt{15}$ **= +/- 26 %**.

The outcome of the quantitative investigation from Finland are represented in figure IV.10 to figure IV.12. These findings are consistent with that of the qualitative interviews presented in section II.3.2.

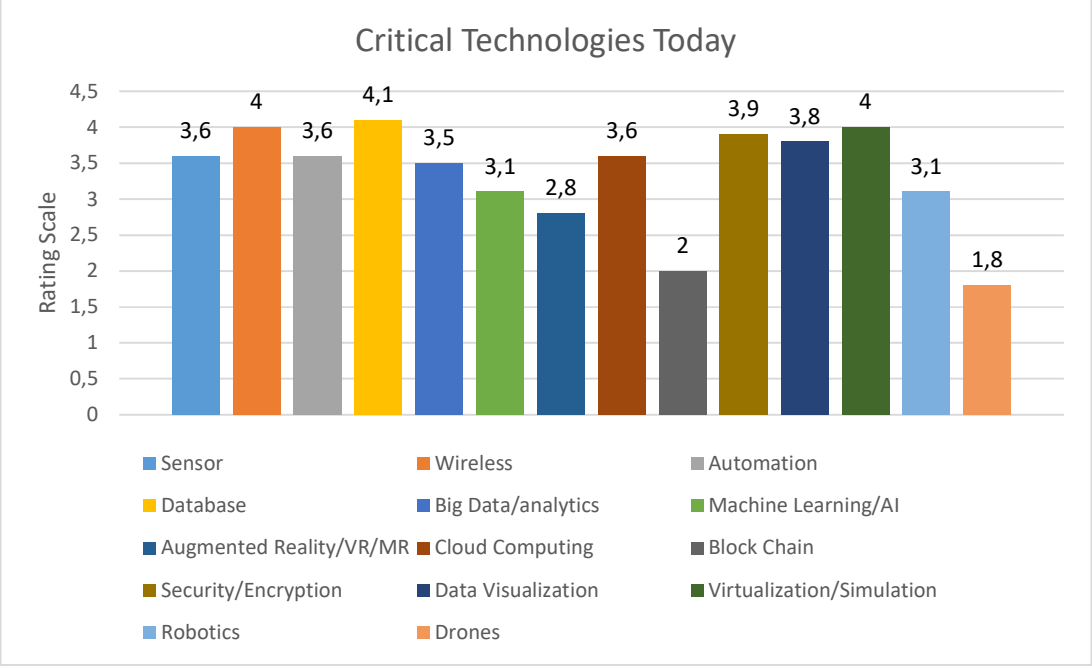

Figure IV.10 Current Critical technologies in Finland

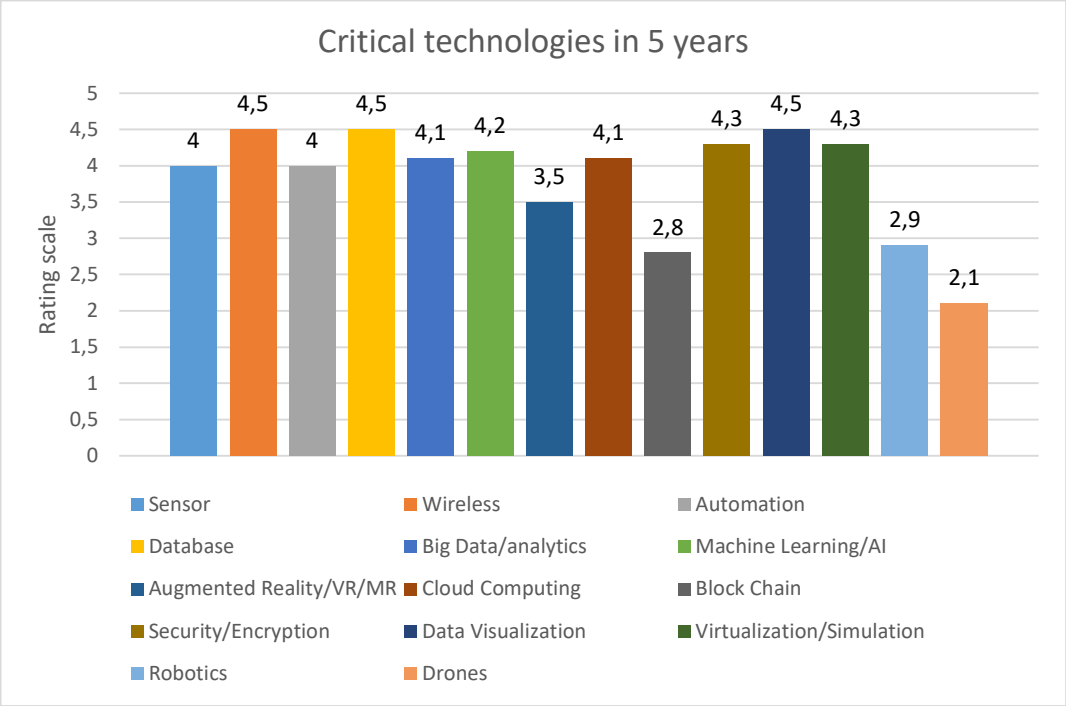

Figure IV.11 Future Critical Technologies in Finland

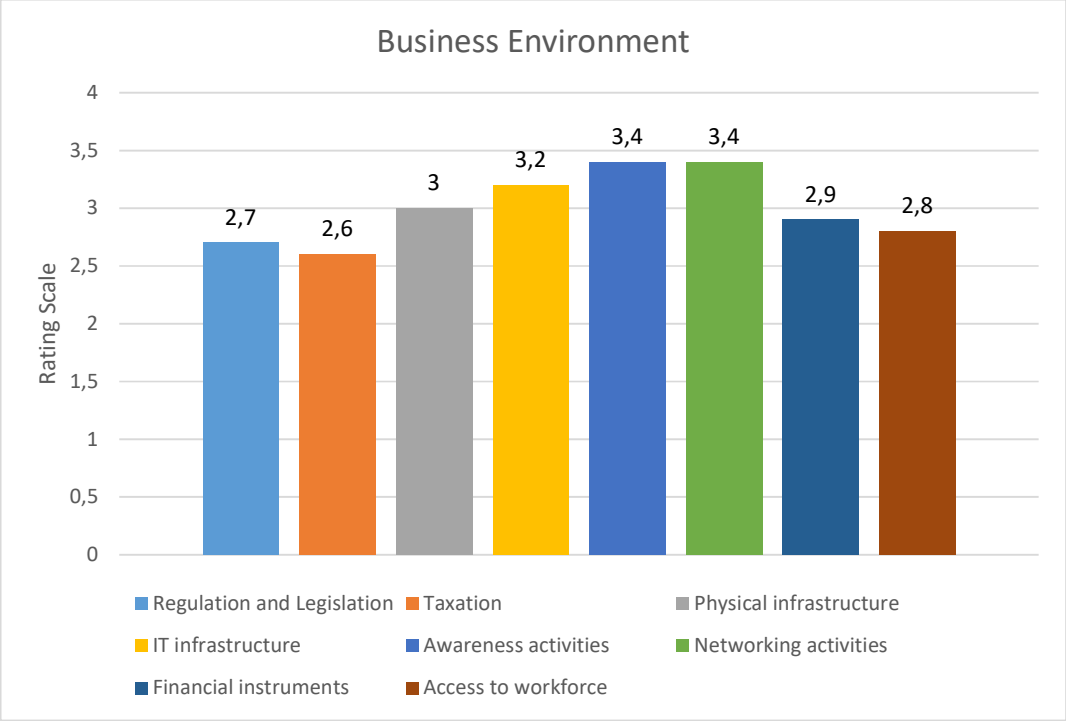

Figure IV.12 Current Business Environment in Finland

Table IV.3 Competition and Partners

Competition and Partners	
Question	**Rating**
Will new business replace existing ones?	2,9
How much will competition increase/decrease due to digitalization	3,9
Will you get new customers in other EU countries?	4,0
Will there be new partners in the implementation of new digital solutions?	4,5
Will new digital possibilities support your existing businesses or create new business areas?	3,3
How much will digitalization affect your business in 2 years?	4,1

IV.3.2 Qualitative data

In this section, the adjusted ratings are presented and analyzed. As mentioned earlier the adjusted ratings are achieved by presenting the results of the quantitative findings during interviews with industry representatives from four companies.

IV.3.2.1. Critical Technologies of Today

Figure IV.13 depicts the ratings concerning different technologies used today. As seen the Finish companies are highly advanced when it comes to the use of digital technologies. The only technologies that have lower ratings are Drones, Block Chain and Augmented Reality /VR/MR. The technologies like Databases, Cloud Computing, Security/encryption and Data Visualization are used intensively in the companies. Just below these technologies, we see Sensors, Wireless, Automation/ Big Data/Analytics, Machine Learning/AI and Robotics.

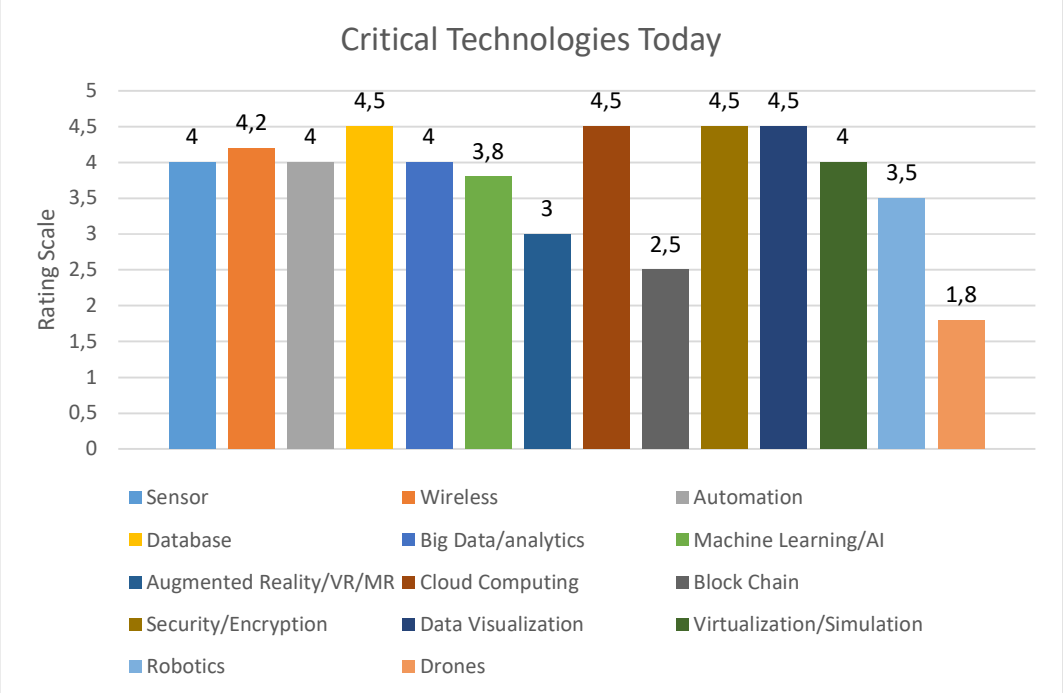

Figure IV.13 Current Critical Technologies in Finland

IV.3.2.2. Critical Technologies in 5 years

Figure IV.14 depicts the ratings of technologies that will be used in the next 5 years. The forecast is that the use of digital technologies continue to be at a very advanced level. The technologies like Augmented Reality/VR/MR, Block Chain and Drones that are not used so much today are foreseen to be used more in the future.

The respondents are not so optimistic on the use of Drones in the future. This is partly because Drones have specific applications and we have not had many companies with products, services or processes that will be affected by Drones amongst our respondents. Moreover, partly because as one of the respondents says the question is too specific: "if we had asked comments about AGV's (Automatic Guided Vehicles), the respond would have been very different. AGV's have a very important role in in-factory logistics, where drones will not have any significant role – not at least in the foreseeable future."

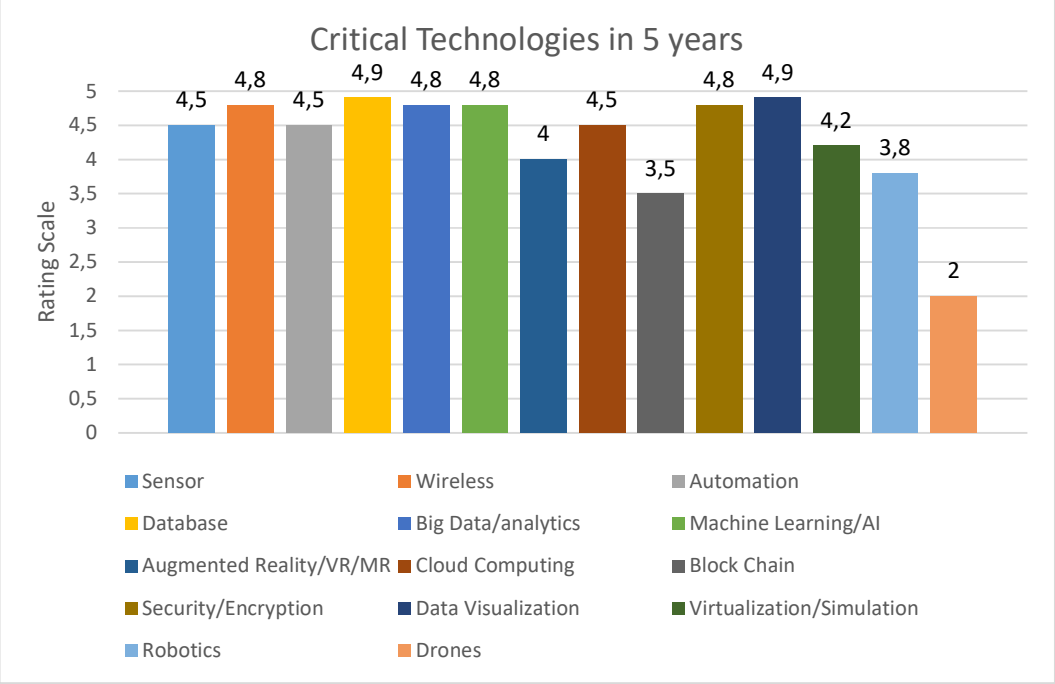

Figure IV.14 Future Critical Technologies in Finland

Some of the respondents indicated other technologies that were not listed in our survey such as display technologies (for example, very thin displays), additive manufacturing, and intelligent coatings.

IV.3.2.3. Business Environment

Concerning the business environment and the kind of support the companies require from the state, industry associations, partners and other organizations to implement new digital solutions into their business, the issues and the ratings are depicted in figure IV.15. *IT and physical infrastructures* and *awareness and networking activates* receive highest ratings and are seen highly important by the companies. These are followed by *Regulation and legislation* and instruments like *taxation* that are seen as important as enablers for the use of digital technologies.

Finally yet importantly, the *access to qualified workforce* is indicated as an important issue. This covers both attracting new employees with relevant digital competencies and upgrading the competencies of the current workforce in the companies through formal and informal education programs.

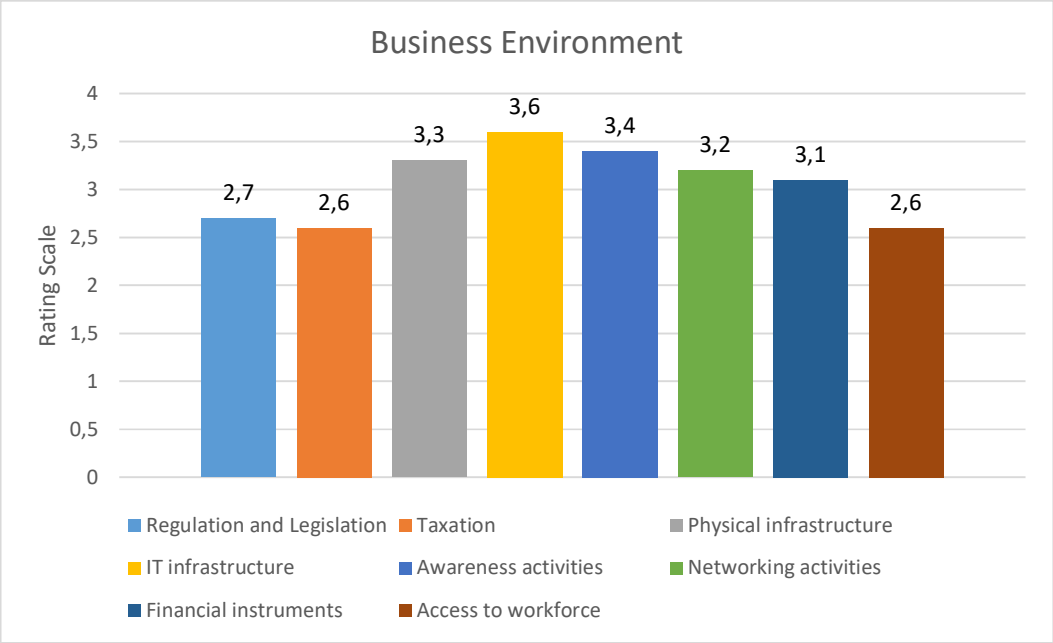

Figure IV.15 Current Business Environment in Finland

IV.3.2.4 Competition and Partners

Table IV.4 lists the attitude of the respondents towards a number of qualitative questions that illustrates the competition situation and the partners due to digitalization. There is high expectations amongst the respondents that digitalization *will affect the businesses in 2 years* and that *there is a need for new partners in implementation of new solutions*. Furthermore, it is obvious that the Finish companies expect that the competition will increase due to digitalization and that they get new customers in other EU countries.

On the questions on if the digital possibilities *support the existing businesses*, create new business areas, or *replace the existing one*s the ratings are more moderate but still we can see expectations that these would be the case.

Table IV.4 Competition and Partners

Question	Rating
Will new business replace existing ones?	3
How much will competition increase/decrease due to digitalization	4,1
Will you get new customers in other EU countries?	4,2
Will there be new partners in the implementation of new digital solutions?	4,4
Will new digital possibilities support your existing businesses or create new business areas?	3,1
How much will digitalization affect your business in 2 years?	4,5

IV.3.3. Summary

The Finnish companies are advanced in the adoption of all digital technologies except for Block Chain and Drones. The major issues are, Regulations, taxation and access to workforce.

IV.4 Sweden

IV.4.1 Quantitative Survey

Following figures and table present the data from the quantitative investigation, where we have received valid responses to the survey from 20 Swedish companies resulting in a margin of error ~ $1/\sqrt{n}$ = $1/\sqrt{20}$ **= +/- 22 %**.

IV.4.1.1. Critical Technologies of Today

Figure IV.16 depicts the ratings concerning different technologies used in the Swedish companies today.

The scores are highest for Cloud Computing, Wireless, Automation, and Security and encryption. At the second level, we see Sensors, robotics, Big data/analytics, Databases, Data visualization and Visualization/simulation technologies.

There are scores below two for Drones and Block Chain, Machine Learning /AI and Augmented Reality/VR/MR score lowest.

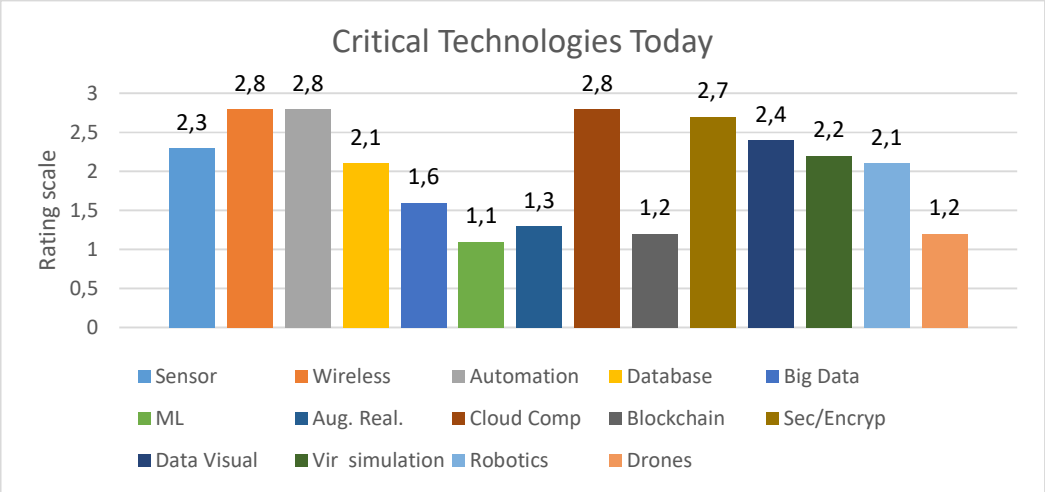

Figure IV.16 Current Critical Technologies in Sweden

The highest rating score on the adoption of the technologies by the respondent is 2,8 while the average rating score is 3.

The relatively low score in Figure IV.16 is – even considering the margin of error – not seen as representative by Swedish experts and is certainly modified/ contradicted by the qualitative results below.

IV.4.1.2 Critical Technologies in 5 years

Figure IV.17 depicts the ratings concerning different technologies that is foreseen to be used in Swedish companies in the next 5 years. The forecast is that the use of current digital technologies will be more advanced in the next 5 years.

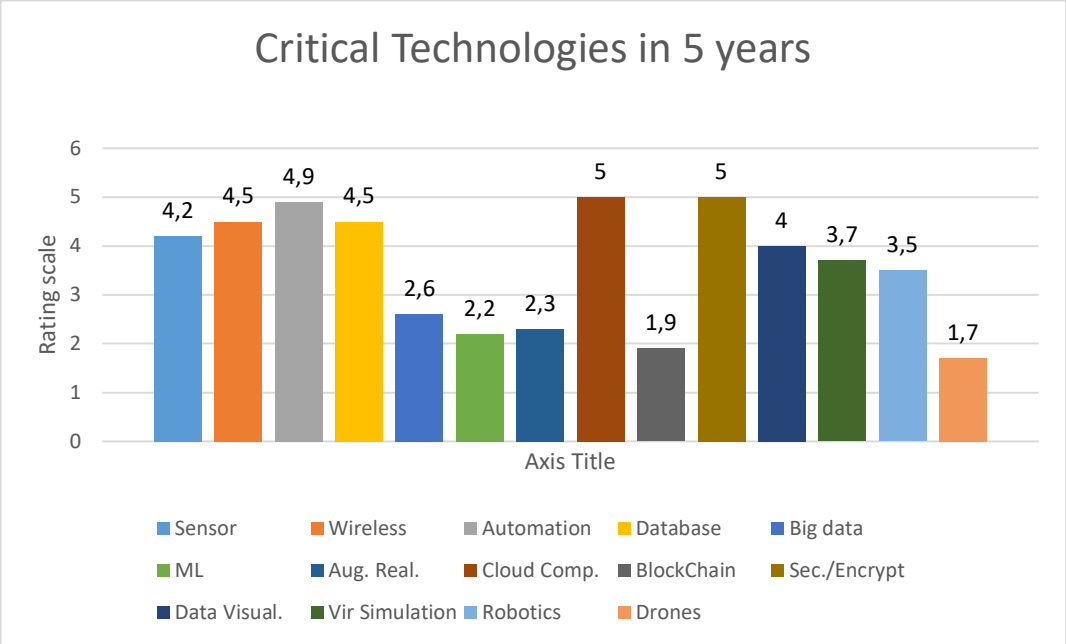

Figure IV.17 Future Critical Technologies Expected in Sweden

This pattern of this figure is similar to that of the previous figure. This implies that the companies provided an assessment based on the technologies, products and services they currently adopt and deliver respectively.

IV.4.1.3 Business environment

Concerning the business environment and the kind of support the companies require from the state, industry associations, partners and other organizations to implement new digital solutions into their business the issues and the ratings are illustrated in figure IV.18.

Access to workforce highest score and are seen highly important by the companies.

On the second level we see *access to IT infrastructure, Networking activities, Financial instrument, Physical infrastructure* and *Awareness and networking activities* and as seen *Regulation and legislation and taxation* receive less scores.

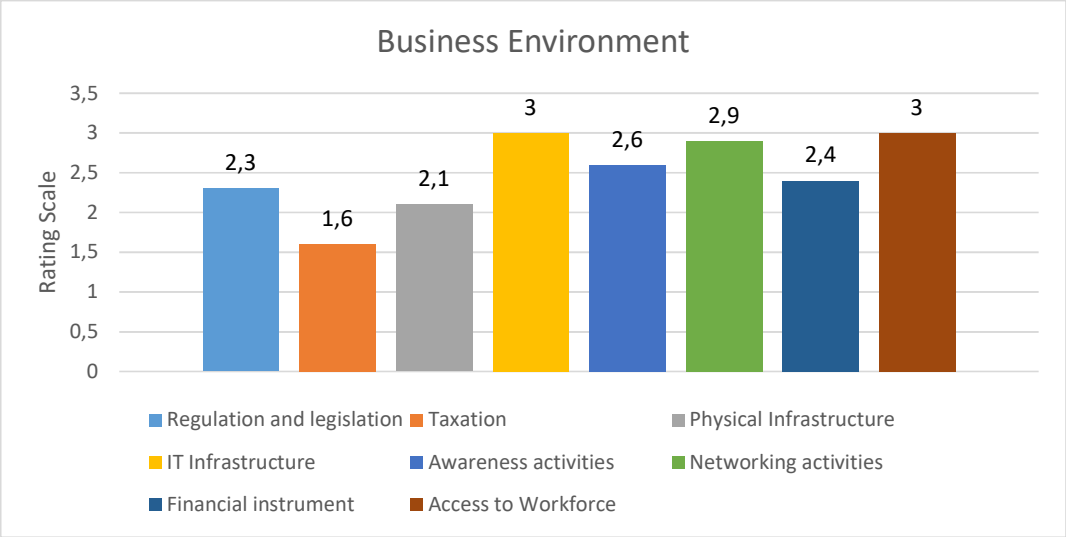

Figure IV.18 Current Business Environment in Sweden

IV.4.1.4. Competition and Partners

Table IV.5 lists the attitude of the respondents towards a number of qualitative questions that illustrates the competition situation and the partners due to digitalization. The expectation to all parameters are at middle level. This can be due to the methodological uncertainty of 5 points scale that when respondents are not so sure they tend to give middle score to the questions.

Table IV.5 Competition and Partners

Question	**Rating**
Will new business replace existing ones?	3,8
How much will competition increase/decrease due to digitalization	3,4
Will you get new customers in other EU countries?	3
Will there be new partners in the implementation of new digital solutions?	3,8
Will new digital possibilities support your existing businesses or create new business areas?	2,8
How much will digitalization affect your business in 2 years?	3,3

IV.4.2. Qualitative Data

1. Which digital technologies (DT1 to DT14, Appendix 1) do you use today in your business, and how would you evaluate your company's ability and readiness to leverage digitalization in comparison with your (current and future) partners, customers and competitors?

Majority of the companies interviewed were users of at least five digital technologies in their businesses.

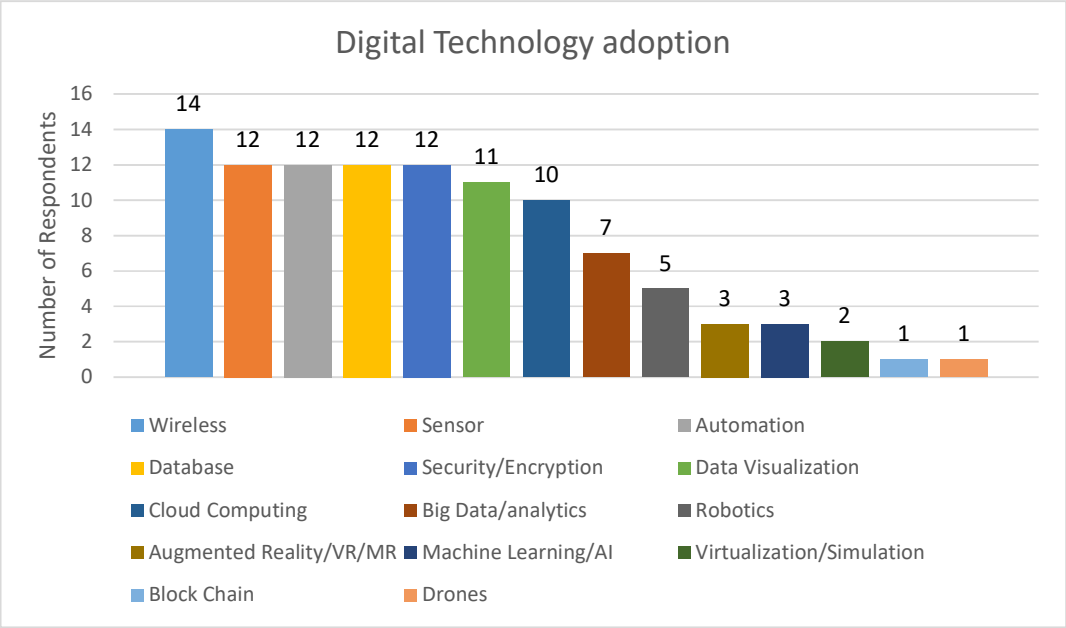

Figure IV.19 Current technologies adopted by Industry in Sweden

As indicated in the figure IV.19 above, at least 12 of the companies interviewed used sensor, wireless, automation database and security/encryption digital technologies in their businesses. At least 10 of them used cloud computing and data visualization technologies. This implied that most of the respondents were highly digitized businesses. The lesser adopted technologies were Machine learning/AI, robotics, Block Chain, Drones and Virtualization/Simulation. There was a moderate adoption of Big/Data analytics among the companies.

What are your strongest areas?

The core area of service provision of each respondent is represented in the table IV.6 below.

Table IV.6 Areas of Service Provision by Swedish Industry Respondents

Respondent	Area of Service provision
Respondent 1	Augmented Reality, Virtual Reality, Mixed Reality, Wireless technology, Data Visualization
Respondent 2	Robotics
Respondent 3	AI, sensor (vision), architecture (hardware and software)
Respondent 4	Flexibility.
Respondent 5	Connectivity of IoT devices
Respondent 6	Robotics
Respondent 7	Color on paper/other materials
Respondent 8	Compile data and coordinate
Respondent 9	Analog thermometers & comp.
Respondent 10	Knowledge
Respondent 11	Radio, sensor & cloud techn.
Respondent 12	High Quality on complex details
Respondent 13	Products & flexibility
Respondent 14	3D drawings & models in prod.
Respondent 15	Flexibility in machinery, environmental & sustainability

Although these companies adopt different digital technologies for their businesses, the level of adoption of different technologies by one company vary from the other. This implies that one or two digital technologies might be the core technology(s), while the rest serve as enabling or supporting technologies. This will obviously imply that the company is strong in the utilization of one technology as opposed to the other.

How do plan to improve your competitiveness in digitalization?

Different respondents have identified plans on how to improve competitiveness using digital technologies. The plan of most respondents is hinged on the on the knowledge of the level of digital competitiveness in their industry. 11 out of 15 companies indicated that digitization of their business as compared to their competitors was high. These companies identify digitization as a means of achieving competitive advantage. Three of the responding companies assessed their level of digitization compared to their competitors as either low or far behind. A company rated its level of digitization compared to other companies as average. However, they understand the need for digitization and have adopted some of the digital technologies being evaluated in this study. Therefore, their competitive strategy differs based on the aspect of their operations they intend to digitalize as seen in the table IV.7 below.

Table IV.7 Actions to improve competitiveness in Digitization by Swedish Industry

	Summary of Responses	**Operational aspect to be digitized**
1.	Increase our work in the AI and Machine Learning	Product enhancement
2.	Develop Machine Learning. Get right expertize & dev. Services.	
3.	Use robots to replace certain tasks staff do today	Automated production
4.	Continue developing solutions. Find new integration solutions	
5.	Update the electricity and automate the production.	
6.	Improve follow-up and key analysis including visualization of production data. Test a cloud-based real-time monitoring of machine cycles (on top).	Product testing
7.	Building cells in a digital world prepare production, test& show	
8.	Remove paperwork and analogue documentation entirely from our production	Production and service delivery
9.	Offer e-commerce & print	Service delivery
10.	Provide services earlier, such as design and construction, and do more consulting.	
11.	Continue to customize our products and services according to customer needs.	
12.	Connecting to people with knowledge	Knowledge acquisition
13.	Access new technology, exploit new systems/services/solutions	Resource acquisition
14.	Digitize administrative / economy / ordering work and automate manufacturing	Operations management
15.	Focus our business more and more abroad due to political decisions & lack of knowledge	Operational expansion

These aspects as highlighted in the table above include the use of the digital technologies to either, enhance their produce; automate production; test the product; deliver their services to the customer; acquire operational resources; manage operations; expand operations and Knowledge acquisition. These are strategic areas where the respondents feel they can improve their level of competitiveness with digitization.

2. Do you have a digital strategy and/or an operational plan for its implementation and what is the period? Please provide a short definition of your digital strategy.

Although there was a high adoption of digital technologies by the respondents, almost half of them do not possess a digital strategy. 9 of the respondents possess a digital strategy, while 6 of the respondents do not possess one. However, one of the 6 respondents, without a digital strategy, has started developing a strategy. The existing digital strategies are either production based digitization strategy or marketing based digitization strategy.

How could digital disruption scenarios look in your business?

Based on their strategies, some of the respondents have identified the effect of digital disruption on their businesses. The effects of digital disruption as identified by the businesses include, the evolving need for changes for small businesses; high mobility of workers to low wage countries due to increasing automation in Sweden; evolving customer needs resulting in the type of product being delivered; and high cost of data security. The respondents did not have direct answers to the disruption they identified; rather they proposed an increase momentum in the digitization effort in Sweden. This was because digitization enables high operational flexibility and a lower cost in switching the line of production.

What would be your company's role and target position?

Furthermore, they have identified what to do to keep their company on top of the digital revolution. In order to stay ahead of in a digitally disruptive market, 12 respondents provided different strategies. These strategies include:

- Having the first movers advantage in the adoption of existing technologies and it's production opportunities;
- the harnessing of AI components in their solutions (2 respondents);
- the positioning to serve customer-centric needs in an efficient manner;
- the harnessing of opportunities as digitization of industry grows in Sweden;
- the reliance on the long-term survival of their niche markets;
- data acquisition and processing aimed at supporting production and service delivery;
- taking advantage of the slow transformation of the plumbing industry from analogue to digital;
- the positioning of operations at the interface between Information Technology and Communication technologies;
- the digitization of project management processes and the digital drawing processes;
- The digitization of time-consuming processes within the industry.

Apart from the 12 respondents, three of the respondents did not have the plans to stay ahead in a digitally disruptive market. One of the three respondents did not foresee the full digitization of the production processes in their industry. They foresaw the future need for human mediated production processes.

Generally, it is observed that most of the respondents do possess a digital strategy. Furthermore, it could be observed that some of the respondents without a digital strategy still possess strategies that would enable them combat digital disruption. However, as in the case of the adoption of current technologies, there is greater awareness of the need for a digital strategy.

3. Could you implement digital solutions by yourself in your organization or do you need help from other companies/partners in a cross-sectoral collaboration, especially with ICT?

In Sweden, the respondents did not indicate the need for support towards adopting the technologies. The respondents provided the technology either by themselves or in partnership with external service providers. 9 out of the 15 respondents implement digital solutions by themselves. 4 of the 9 respondents outsource part of their implementation processes. 6 of 15 respondents them totally outsource the implementation of digital solutions.

Have you established any such (new) contacts or relations?

12 respondents work with partners. Their partner companies are Swedish, Estonian, France, Denmark, Germany, United States of America and China. Some of these partners are local partners such as PE Accounting (Sweden), OneFlow (Sweden), and VF in Gothenburg. The international partners include PipeDrive (Estonia), Intercom (USA), Microsoft, IBM and IBS.

4. Which digital disciplines do you need in your business to implement your digital strategy?

In order to build upon their existing technological solutions, the respondents requested competence on technologies they use the most.

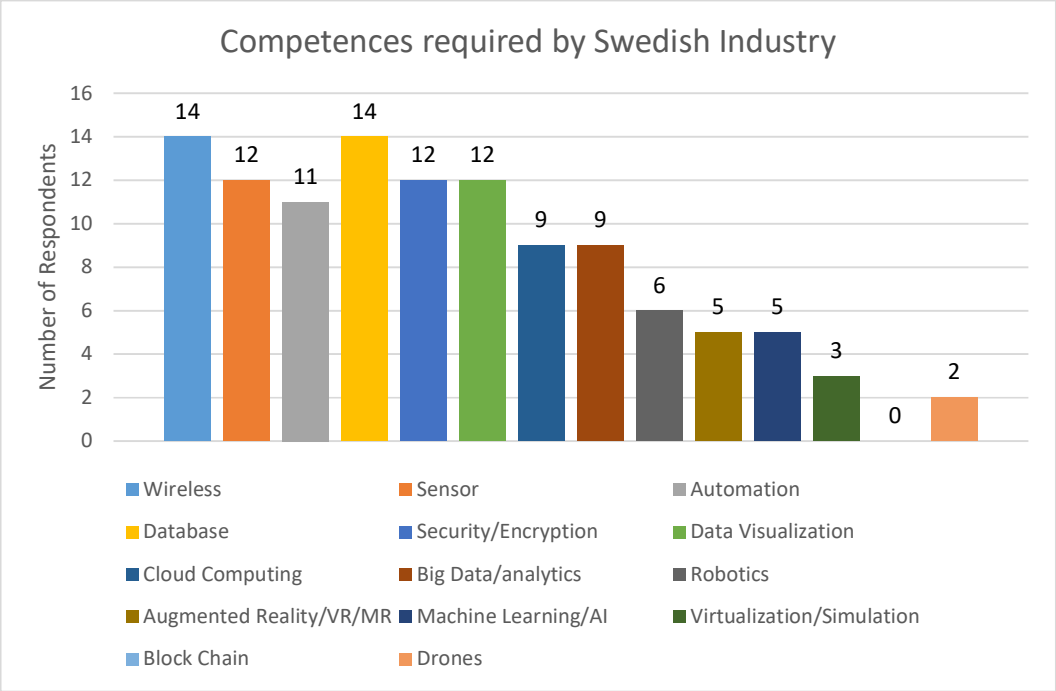

Figure IV.20 Competences required by Swedish Industry

As seen in figure IV.20, there is a greater need for competence in wireless and database technologies. This is followed by the need for competences in Sensor, automation, Big data, Cloud computing, security/encryption and data visualization. Few respondents had the need for competences in robotics, augmented reality/VR/MR, machine learning/AI, Virtualization/simulation and drones. None had the need for competence in Block Chain. The reason for the low numbers is that fewer respondents had products, which required these technologies for production or service delivery purposes.

5. Which of your products/services are, to some extent, based on the current state of digital technology. How many products/services in percentage?

5 respondents from Sweden has products that were developed using these technologies. These were respondents 3 (R3),4 (R4),5 (R5),11 (R11) and 12 (R12). Respondent 7 (R7) utilized 7 of the 14 digital technologies in their product development process. These facts are represented in the table IV.8 below.

Table IV.8 Digital Products used by Respondents in Service and Product Delivery

	Digital Technology	Respondents
1	Sensor	R1, R3, R4, R5 ,R7, R11,R12
2	Wireless	R1, R3, R4, R5, R7, R11, R12
3	Automation	R3, R4, R5,R7, R11, R12
4	Database	R3,R4, R5, R7, R11, R12
5	Big Data /Analytics	R3,R4, R5, R7, R11, R12
6	Machine Learning/AI	R3,R4, R5, R11, R12
7	Augmented Reality /VR/MR	R1, R3, R4, R5, R11, R12
8	Cloud computing	R1, R3,R4, R5, R7, R11, R12
9	Block chain	R3,R4, R5, R11, R12
10	Security/encryption	R3, R4, R5, R7, R11, R12
11	Data visualization	R3, R4, R5, R11, R12
12	Virtualization/Simulation	R3, R4, R5, R11, R12
13	Robotics	R2,R3, R4, R5, R11, R12
14	Drones	R3,R4, R5, R11, R12

Respondent 1 (R1) and 2 (R2) utilized 4 and 1 of the digital technologies respectively. Respondent 1 utilized the technologies for their customer projects, Wireless communications (IoT), cloud –based platforms and Augmented Reality /VR/MR. Respondent 2 utilizes the technologies to develop SW platforms for tele-robotics and telepresence for industries and home environment.

Respondent 6 (R6) is not represented because they did not specify what they use the product for. However, they indicated that 70% of their products are not digital.

Respondent 8 (R8), not also represented in the table, use the digital tools to for packaging, production, product traceability and transparency. This could imply robotics and big data.

Respondent 9 (R9), not represented in the table, produce 90% of their digital tools using the digital technologies.

Respondent 10 (R10), not represented in the table, deliver 30% of their building documents, drawings and system documents using the digital tools.

Respondent 15, not represented in the table, use the digital tools to develop services for their partners. They are sub-contractors.

Respondents 13 and 14 do not produce services using the digital tools. This does not imply that they do not use digital tools at all. As indicated in question 2B, R13 and R14 utilize digital technologies in their business processes and not strictly on product development.

The general outcome of these findings is that most of the respondents adopt digital technologies in their product development process.

6. Have you activated or started any plan or activities for your organization to acquire digital awareness or knowledge?

Nine respondents have organizational activities aimed at raising digital awareness in their companies. For three of the 15 respondents, digital awareness is the prerogative of the staff and not the organization. Two of the 15 respondents had no plans for digital awareness. One of the 15 respondents is in the process of creating a digital awareness plan.

For the nine respondents with awareness plans, a summary of their combined digital awareness activities are as follows:

- Internal knowledge sharing and organizational learning activities. This is facilitated via:
    - Competence sharing exercises organized by the organization.
    - Facilitation of in-house training for staff and a follow up on their progress.
    - The creation of a knowledge-sharing environment where personnel with knowledge can share that knowledge in the organization.
    - The follow-up and key analysis, visualization of production data and cloud-based real-time monitoring tools in order to learn about the output of the digital technologies such as sensors etc.

- External knowledge acquisition through fairs such as Scanpack in Gothenburg and fairs in Germany.
- Top-down directives on how a product should be developed as driven by customer demands.
- Employment of competent staff who are knowledgeable about the technology.
- The introduction of new business systems that will compel the staff to learn about it.

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IV.4.3. Summary

The Swedish companies are advanced in the adoption of digital technologies. The average scale indicating the importance of these technologies today, for the quantitative interview was low at 2.0, but as mentioned above, this is not considered valid. In the qualitative interviews at least 80% of the respondents identified security and encryption, database, sensors, wireless and automation as the technologies, which are critical today. These are communication and data driven technologies. Other data-driven technologies and drones were not considered critical. However, they expect the current critical technologies in addition to drones and virtual simulation to be critical in the next five years.

The respondents have modest expectations towards competition in the market and partnership. This is because as seen in the qualitative data, some of them are already collaborating with partners and adopt a dynamic operational strategy.

Furthermore, most of the Swedish respondents possess documented digital strategies and expect competences mostly in their area of operation. Seen from the quantitative data. The impression extracted from the qualitative data is that the Swedish market is highly competitive and slightly volatile with tax incentives and deregulation in certain areas required. Hence, at some point the regulation of competition might be required to keep the existing companies afloat.

IV.5. Latvia

IV.5.1 Quantitative Survey

Following figures and table present the data from the quantitative investigation, where we have received valid responses to the survey from 18 Latvian companies implying a margin of error $\sim 1/\sqrt{n} = 1/\sqrt{20}$ = **+/- 22 %**.

IV.5.1.1 Critical Technologies of Today

Figure IV.21 depicts the ratings of the different technologies used in the Latvian companies today. The scores are highest for Databases, Wireless and Automation. At the second level are Sensors, Data visualization, Visualization/simulation technologies, Cloud Computing, Robotics and Security and encryption. There are scores below 2 for Big data/analytics, Drones and Block Chain, Machine Learning /AI and Augmented Reality/VR/MR score lowest.

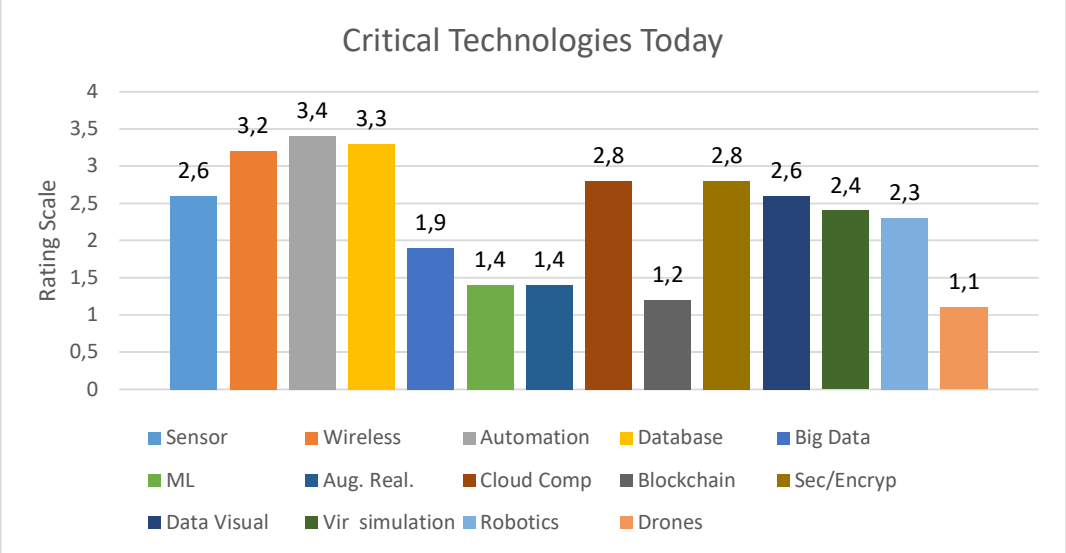

Figure IV.21 Current Critical Technologies in Latvia

The highest rating score on the adoption of the technologies is 3,2 while the average rating score is 2,3. The low score does not necessarily depict the adoption of the critical technologies in Latvia. It is rather because the respondents use varying percentage of the combination of these technologies to develop their products and services. Figure IV.21 however does reflect the technologies adopted by the respondents. It further reveals the technologies that are most adopted and those that are least adopted by the respondents.

IV.5.1.2. Critical Technologies in 5 years

Figure IV.22 depicts the technologies that are foreseen to be used in the next 5 years. As seen in the figure the forecast is that use of digital technologies will be more advanced in the next 5 years.

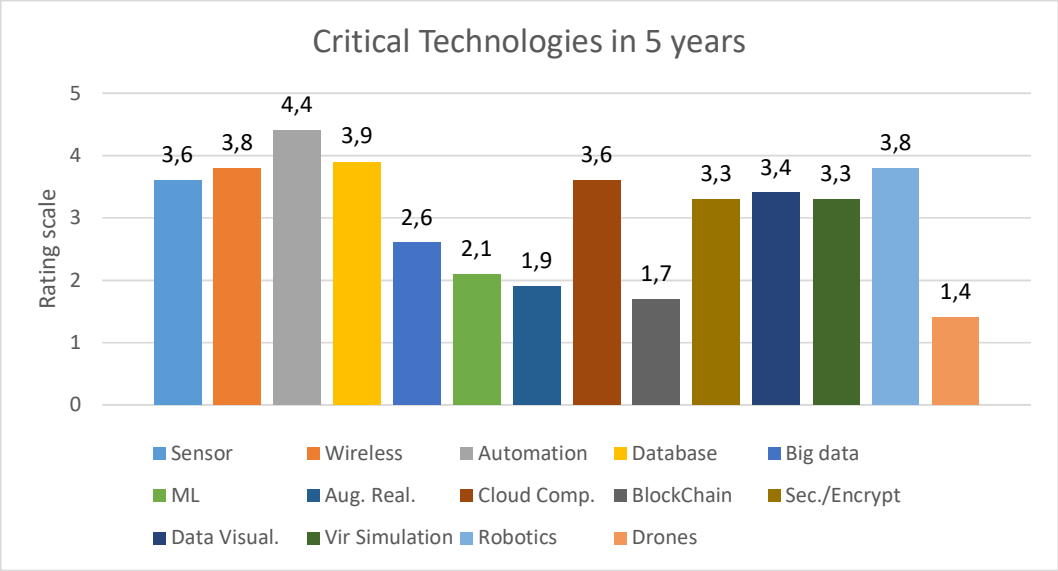

Figure IV.22. Future Critical Technologies in Latvia

The pattern in figure IV.22 is not close to that of figure IV.21. The similarities lay in the expectation towards using current technologies or their upgrades in the next 5 years. The differences lay in the fact that the respondents expect to use more of some of the technologies than others did. For example, they expect to use more of automation, wireless, sensors, cloud computing, databases and growth in the use of robotics. In a sense they foresee a future driven by robots, IoT, machine-to-machine communications all enabled by wireless networks.

IV.5.1.3. Business environment

The issues and the ratings of the business environment and the kind of support the companies require from the state, industry associations, partners and other organizations to implement new digital solutions into their business a number of issues where raised are in figure IV.23.

As seen in the figure *IT infrastructures* highest score and are seen highly important by the companies. Furthermore, *regulation and legislation* are also seen as very important

On the second level we see *access to qualified workforce*, *Physical Infrastructures*, *Awareness and networking activities, financial instrument and taxation*.

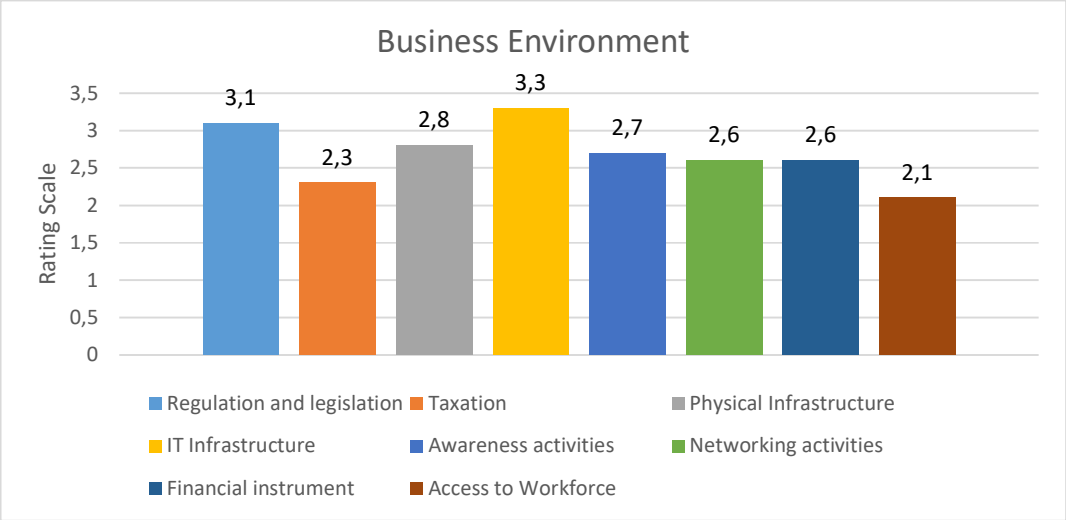

Figure IV.23 Current Business Environment in Latvia

IV.5.1.4. Competition and Partners

Table IV.9 lists the attitude of the respondents towards a number of qualitative questions that illustrates the competition situation and the partners due to digitalization. As seen in the table there the expectation to all parameters are at the middle level on the average. This can be due to the methodological uncertainty of 5 points scale that when respondents are not so sure they tend to give middle score to the questions.

Table IV.9 Competition and Partners

Question	Rating
Will new business replace existing ones?	3,1
How much will competition increase/decrease due to digitalization	3,7
Will you get new customers in other EU countries?	3,8
Will there be new partners in the implementation of new digital solutions?	3,8
Will new digital possibilities support your existing businesses or create new business areas?	2,4
How much will digitalization affect your business in 2 years?	3,2

IV.5.2 Qualitative Data

1. Which digital technologies (DT1 to Appendix 1) do you use today in your business, and how would you evaluate your company's ability and readiness to leverage digitalization in comparison with your (current and future) partners, customers and competitors?

Automation, database and wireless technologies are the most popular digital technologies adopted by industry. Drones, Block Chains and Augmented Reality / Virtual Reality / Mixed Reality are the least popular ones. The readiness and ability to digitize processes is generally low. However, the level of digitization is higher in the electronics sector than in the mechanical & metalworking sector.

The most widely used digital technologies are automation, robotics, machine learning and data visualization. Based on the feedback from the respondents, most of the production processes are not digitized. Full digitization is impossible due to the following identified reasons:

- the lack of skilled human capital;
- the Low level of attraction of funds;
- the low introduction and use of technologies;
- the difficulties in identifying the benefits of certain digital technologies;
- the difficulties in identifying how certain digital technologies will facilitate the companies competitiveness;
- the differences in the usage of IT concepts in their translation over the lexicon of the various industry professionals.
- the existence of many misconceptions and prejudices.

What are your strongest areas?

The focus of most respondents is on the management system that accepts orders, executes work orders, and the operator only monitors the process.

How do plan to improve your competitiveness in digitalization?

The respondents has no plans toward improving their competitiveness in digitization.

2. Do you have a digital strategy and/or an operational plan for its implementation and what is the period? Please provide a short definition of your digital strategy.

The respondents identify the need and importance of a digital strategy. However, only one of them indicates that some Latvian companies do have digital and growth strategy.

What changes are you afraid of?

Some reflections on the negative effects of digitization on their business. These effects include the cyber threats, communication and power outage, the lacking knowledge and competence of employees and the exodus of competent personnel to countries with high wages. These

problems could be summed up as that of low human and operational capacity faced by the companies.

3. Could you implement digital solutions by yourself in your organization or do you need help from other companies/partners in a cross-sectoral collaboration, especially with ICT?

None of the companies interviewed had the potentials of developing digital solutions on their own. This is because they lacked the resources needed to develop bigger digital solutions. However, the companies have been successful in developing digital solutions via partnerships. SIA Peruza as an example has been cooperating with Latvian, Lithuanian and Dutch companies and is still looking for more successful options. They are currently developing a partnership with a Belgian company. They are also searching for partners that are more global.

Although the respondents work in synergy with partners, these partnerships are not without its challenges. A challenge identified by the respondents is that companies are interested in cooperation, but do not always trust and each other to discuss about existing solutions and future plans. Another challenge is that representatives from different sectors of the economy know little about each other, which makes partnership difficult. The respondents suggested intensive exchange of information via the organization of practice-oriented events where demand partners meet supply partners. They further suggest the need for an interdisciplinary education, so that a broader vision can be created at the initial stage of education. This would enable future partners identify ways on how they can work together.

4. Which digital disciplines do you need in your business to implement your digital strategy?

As seen in the figure below, 80% respondents indicated their need for competent employees in data visualization, and wireless technologies. Few companies indicated their need for competences in robotics, sensors and drones.

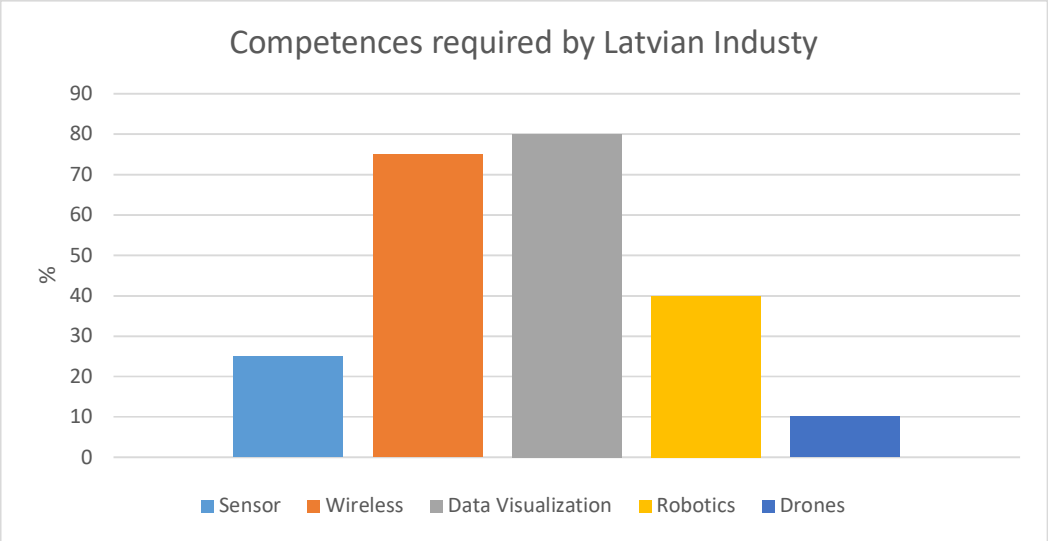

Figure IV.24 Competences required by Latvian Industry

The respondents do not require the need for competence in technologies such as Block Chain, Automation, Databases, Big Data/Analytics, Machine Learning/AI, Augmented Reality/VR/MR, Cloud Computing, Security/Encryption and Virtualization/Simulation.

5. Which of your products/services are, to some extent, based on the current state of digital technology. How many products/services in percentage?

The respondents indicated that the products they create are based on digital technologies. They further indicated that Cloud based services are used by some of the respondent for the company's management processes.

Some of the respondents are currently researching towards understanding the solutions to use, and purchase in order to digitize most of the services offered.

The challenge they face in developing digitally based products is the capital investment required. Hence, industrial companies need to evaluate each time how much of the products / services they create today are based on digital technology and if the particular benefit of the product will pay off. Often the result is negative. Hence developing a digital solution comes with some risk.

6. Have you activated or started any plan or activities for your organization to acquire digital awareness or knowledge?

Responses from the respondents' points to a four prong approach to awareness creation.

- Awareness creation aimed at competence development.
    - The response received indicates that the situation in the vocational education sector has improved significantly. This is because dialogue is being established between industry and schools, stating the needs of enterprises. Hence, awareness to the digital technologies is created for potential future employees of the companies.
- Awareness creation via in-house capacity building and knowledge sharing initiatives
    - The respondents also organize In-company training to improve the understanding of the company's employees about the availability and use of digital technologies.
    - In Peruza Ltd., they have employed a process development manager who is aware of all the company's needs. This employee solves all the needs step-by-step. In this way, the employee learns about the new technology via practice.
    - Some respondents point to the need to promote human capital knowledge development and use of digital technologies so that they can monitor production processes even after a digitization process.
- Awareness creation via external agencies
    - The companies also utilize "centers of competence" that offer a wide range of offerings, engineering innovation projects, etc. activities for their staff. There are also teachers and trainers engaged to improve their qualifications.

- LTRK is working on training of its members. The organization has 2500 members, who are offered relevant opportunities, incl. partially financed EU curricula.

- Resort to more automation

  - The respondents identify shortage of skilled labor by as the main problem. They have introduced automated systems as a partial solution to this problem, in order to be able to increase production capacity. Here existing employees learn on the job.

What kind of support would you require from the state, industry associations, partners and other organizations to implement new digital solutions into your business?

The respondents identified the need for support from higher education institutions and the state in the following areas.

- Development of competence of future employees
  - The respondents stressed that issues related to digital transformation should also be included in study programs in order to develop the competence of future employees.
  - They also suggested that Higher education institutions should further encourage the practice of young professionals in the chosen field and ensure that they can work in projects with appropriate qualifications.

- State interventions on human capital development

  - The respondents demand for available support tools for entrepreneurs, which will include various types of training and competency program for developing new product technologies.

- State interventions on demand aggregation: The respondents identify the need of the state in aggregating demand for the digital technologies. They expect the state to provide demand aggregation support in the following ways.

  - Having an open discussion on the challenges where digital technologies can serve as a solution.

  - The facilitation of awareness creation events and interdisciplinary co-operation between industry partners by the state.

  - Timely and predictable business oriented information from the state in order for the industry players to plan appropriate actions and respond accordingly to those demands.

  - The proposal of projects that can deliver real, visible and measurable results within a short period.

IV.5.3. Summary

The Latvian companies who responded to the qualitative interviews and quantitative surveys are not advanced in the adoption of digital technologies. These companies adopt both communication technologies and data-driven technologies. There is the optimism towards the adoption of more of these technologies as the need arises in 5 years' time. Most of them do not have a documented digital strategy and they rely on strategic partnerships to aid the delivery of their services.

Based on feedback from the qualitative and quantitative data, the industries feel crippled greatly by regulations and the lack of IT infrastructure. They are also affected by the access to qualified work force. Although other issues are mentioned, these are issues that echoed strongly in the qualitative and quantitative data. There is the need for facilitation policies that will aid companies develop the IT infrastructure. This could be via a Public Private Partnership or strategic project initiatives promoted by the public sector. There is also need for educational policies that will look into possibilities for competence development. In addition, there is the need for knowledge sharing clusters, where staffs from various companies could collaborate on a project to enable knowledge transfer among other.

IV.6 Estonia

IV.6.1 Quantitative Data

Following figures and table present the data from the quantitative investigation, where we have received valid responses to the survey from 26 Estonian companies implying a margin of error ~ $1/\sqrt{n} = 1/\sqrt{26}$ **= +/- 20 %**.

IV.6.1.1. Critical Technologies of Today

Figure IV.25 depicts the ratings concerning different technologies used in the Estonian companies today.

The scores are highest (3 and above) for Databases, Automation, Data visualization, Robotics, Cloud Computing, Sensors, Wireless and Security and encryption. At the second level (2 and above), we see Big data/analytics, Machine Learning /AI, Block Chain and Drones and Visualization/simulation technologies.

There is a low score for augmented reality/VR/MR; it scored the lowest.

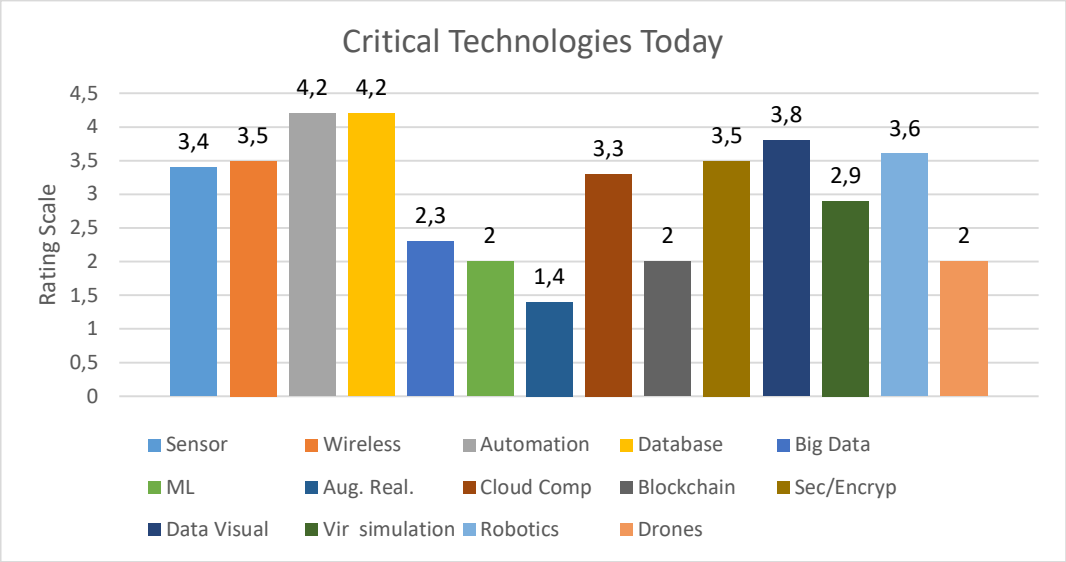

Figure IV.25 Current Critical Technologies in Estonia

The highest rating score on the adoption of the technologies by the respondent is 4,2 while the average rating score is 3. It reveals the technologies that are most adopted and those that are least adopted by the respondents. However, based on the figure above, the companies have found the business case and the societal needs that needs the support of services and products designed from these technologies. This is why they have utilized a wide range of these technologies.

IV.6.1.2. Critical Technologies in 5 years

Figure IV.26 depicts the ratings concerning different technologies that is foreseen to be used in the next 5 years by the companies. The forecast is that the use of digital technologies will be more advanced in the next 5 years.

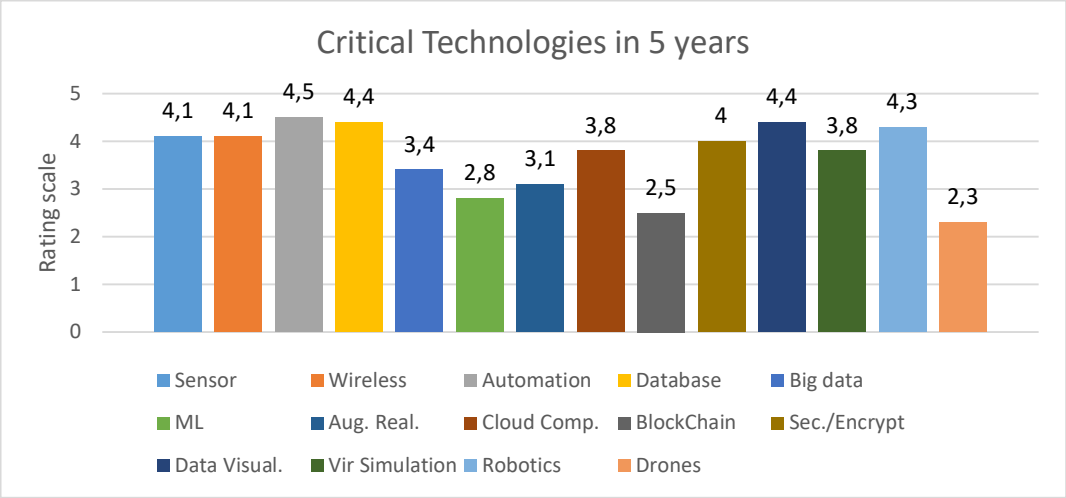

Figure IV.26 Future Critical Technologies

The pattern in this figure is not similar to that of the previous figure because the respondents currently adopting the technologies do expect moderate growth in the adoption of these technologies in the next 5 years. Hence, the least rating provided for each technology is above the scale of 2. However, areas where they identify as critical are area where they have investments at the moment.

IV.6.1.3. Business environment

The issues and the ratings concerning the business environment and the kind of support the companies require from the state, industry associations, partners and other organizations to implement new digital solutions into their business are illustrated in figure IV.27.

As seen in the figure *Networking activities* has the highest score and are seen highly important by the companies.

On the second level we see *access to qualified workforce*, *Physical Infrastructures, IT infrastructure, Awareness and networking activities, Regulation and legislation and taxation*.

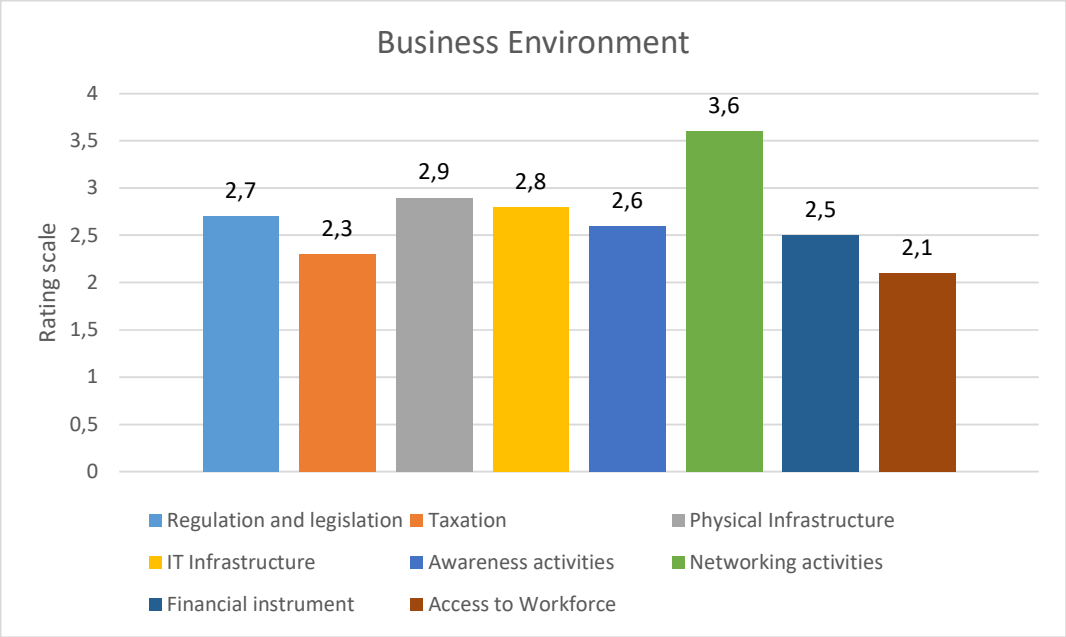

Figure IV.27 Current Business Environment in Estonia

IV.6.1.4. Competition and Partners

Table IV.10 lists the attitude of the respondents towards a number of qualitative questions that illustrates the competition situation and the partners due to digitalization. As seen in the table there the expectation to all parameters are at middle level. This can be due to the methodological uncertainty of 5 points scale that when respondents are not so sure they tend to give middle score to the questions.

Table IV.10 Competition and Partners

Question	Rating
Will new business replace existing ones?	3,5
How much will competition increase/decrease due to digitalization	2,9
Will you get new customers in other EU countries?	3,6
Will there be new partners in the implementation of new digital solutions?	3,7
Will new digital possibilities support your existing businesses or create new business areas?	3,4
How much will digitalization affect your business in 2 years?	3,2

IV.6.2. Qualitative Data

1. Which digital technologies (DT1 to DT14, Appendix) do you use today in your business, and how would you evaluate your company's ability and readiness to leverage digitalization in comparison with your (current and future) partners, customers and competitors?

The focus group participants identified various digital technologies and solutions they adopt. These technologies and solutions were:

- Enterprise Resource Planning Systems (ERP),
- Cloud computing,
- sensor technologies,
- CAD/CAM technologies,
- MES (manufacturing execution systems)
- Solutions for monitoring processes,
- Scanner solutions based on EAN codes.
- 3D-solutions (mostly in the timber industry).
- Robots and automated

Only one company admitted that they have interfaced all their solutions using Big Data for compiling reports. Machine Learning in financing and implementing the RFID solution for monitoring the transport of its products was also used. Digital technologies has significantly increased their competitiveness up to 40%, e.g., by monitor processes in real time and plan more efficiently. Digitalization has significantly increased credibility in the eyes of customers; e.g., delivery accuracy, speed, and quality have all improved. The technologies that are mentioned nor implied as being adopted include Block Chain technologies and Drones.

2. Do you have a digital strategy and/or an operational plan for its implementation and what is the period? Please provide a short definition of your digital strategy.

Two out of 12 companies currently have a strategic approach. For most of the companies, implementing digitization was rather a reactive than proactive issue. In conclusion, a strategic

approach is extremely important for implementing digital technologies in a company, and while all companies understand its necessity, many do not have a related strategy in place.

What changes are you afraid of?

The companies are generally not satisfied with the existing knowledge and skills of their employees on digital technologies. Hence, there is the risk of lack of competent personnel over time.

3. Could you implement digital solutions by yourself in your organization or do you need help from other companies/partners in a cross-sectoral collaboration, especially with ICT?

The participants in the focus group identified strategic partnerships as their strategy in the digitization process.

- All focus group companies cooperated with various partners preferable Estonians but also European.
- Important that employees have the necessary ICT competence
- One limitation in cooperating with ICT partners was their availability, e.g. companies have to wait for different solutions very long and this hinders them from applying digital technologies.
- Smaller or Russian-speaking companies also indicated the importance of language in choosing their partners. They found that involving English-speaking partners could be problematic because of the language barrier.

5. Which of your products/services are, to some extent, based on the current state of digital technology. How many products/services in percentage?

The focus group respondents also utilize digital technologies to facilitate the whole internal supply chain, e.g., to unify all applied systems where each level can share information and give feedback to others during the processes. It is extremely time consuming and requires additional effort.

Respondents use digital technologies to schedule the maintenance of different equipment as well as the automation and digitalization of the scheduling process. This will aimed at improving productivity and prevent failures.

Respondent from mechanical engineering companies prefer to use digital technologies to monitor important parameters for exploitation of their devices to offer their customers a better maintenance service.

6. Have you activated or started any plan or activities for your organization to acquire digital awareness or knowledge?

Only one company has developed a special program to improve digital competence on different levels. Their upper level management conducts seminars and brainstorming sessions twice a year to introduce new digital solutions, and also organizes internal digital training and publishes a digital newspaper. This company asks for employee opinions on

different solutions and in case of a good suggestion is received, respective employees are rewarded.

IV.6.3. Summary

The Estonian companies are advanced in the adoption of digital technologies such as database, automation, wireless, robotics, data visualization and security and encryption. The average scale indicating the importance of these technologies today, for the quantitative interview was 3,0. These companies adopt both communication technologies and data driven technologies. They use these technologies to digital products, which serve as enablers in the manufacturing sector. The respondents expect all the technologies except, drones, Block Chain and Machine Learning technologies to be critical in the next 5 years. They operate in collaboration with local and global partners to deliver their solutions.

However, most of the respondents do not have documented digital strategies and their business need is networking. They require networking as a means to creating synergies in the development of their products.

IV.7. Poland

IV.7.1 Quantitative Data

Valid responses to the survey were received from 21 Polish companies implying a margin of error ~ $1/\sqrt{n} = 1/\sqrt{21}$ **= +/- 22 %**.

IV.7.1.1. Critical Technologies of Today

Figure IV.28 depicts the ratings concerning different technologies used in the Polish companies today.

The scores are highest (Scale 3 and above) for Databases, Cloud Computing, Wireless, Sensors, Automation, Big data/analytics, Data visualization, Security and encryption, Robotics and Visualization/simulation technologies.

At the second level (Between scale 2 and 3), we see Block Chain, and Machine Learning /AI.

Drones and Augmented reality/VR/MR score lowest.

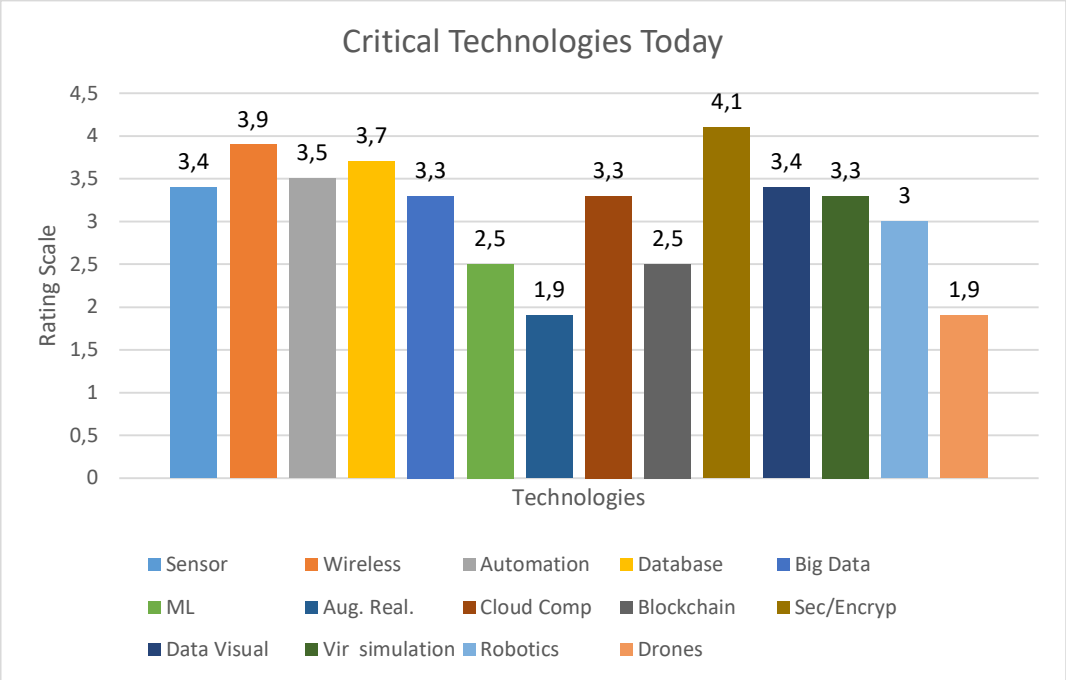

Figure IV.28 Current Critical Technologies in Poland

The highest rating score on the adoption of the technologies by the respondent is 4,1 while the average rating score is 3.1. It reveals the technologies that are most adopted and those that are least adopted by the respondents. However, based on the figure above, these companies have also found the business case and the societal needs that needs the support of services and products designed from these technologies. This is why they have utilized a wide range of these technologies.

IV.7.1.2. Critical Technologies in 5 years

Figure IV.29 depicts the ratings concerning different technologies that is foreseen to be used in the next 5 years. The expectation is that use of digital technologies will be more advanced in the next 5 years. Drones and Augmented Reality which is not utilized much today, is expected to be used in a greater scale than its current stage of adoption now.

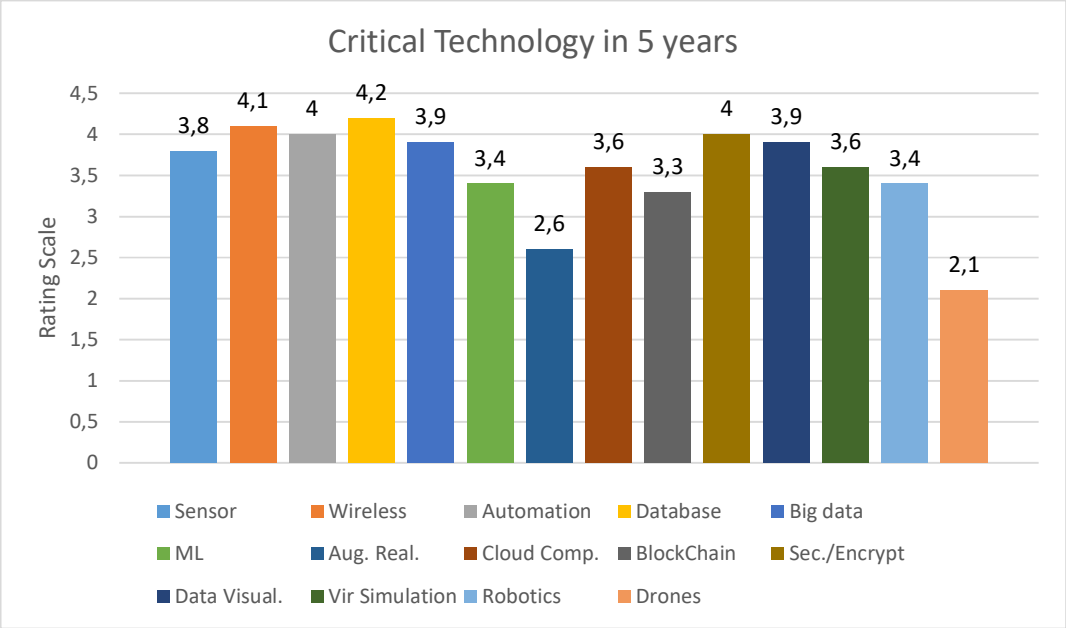

Figure IV.29 Future Critical Technologies

IV.7.1.3. Business Environment

The issues and the ratings concerning the business environment and the kind of support the companies require from the state, industry associations, partners and other organizations to implement new digital solutions into their business are illustrated in figure IV.30.

As seen in the figure *IT infrastructures* highest score and are seen highly important by the companies.

On the second level we see *access to qualified workforce*, *financial instrument*, *Physical Infrastructures*, *Awareness, networking activities, Regulation and legislation and taxation*.

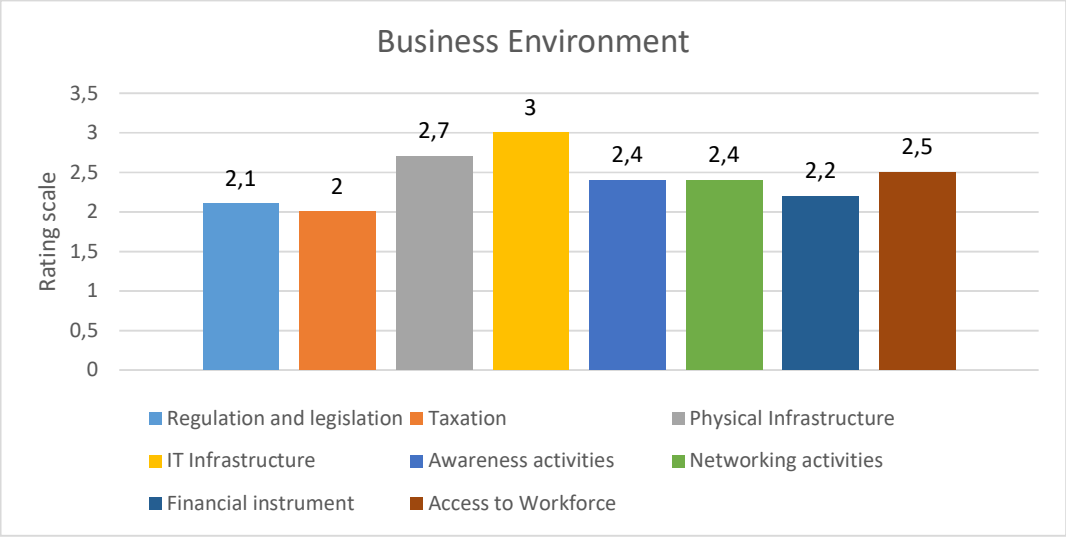

Figure IV.30 Current Business Environment in Poland

IV.7.1.4. Competition and Partners

Table IV.11 lists the attitude of the respondents towards a number of qualitative questions that illustrates the competition situation and the partners due to digitalization. As seen in the table there the expectation to all parameters are at middle level.

Table IV.11 Competition and Partners

Question	**Rating**
Will new business replace existing ones?	3,1
How much will competition increase/decrease due to digitalization	3,5
Will you get new customers in other EU countries?	3,3
Will there be new partners in the implementation of new digital solutions?	3,2
Will new digital possibilities support your existing businesses or create new business areas?	2,8
How much will digitalization affect your business in 2 years?	3,4

IV.7.2. Qualitative Data

1. Which digital technologies (DT1 to DT14, Appendix 1) do you use today in your business, and how would you evaluate your company's ability and readiness to leverage digitalization in comparison with your (current and future) partners, customers and competitors?

15 responses were received from Poland. The adoption of digital technologies by the respondents is high. At least three quarters of the respondents adopt Database, Wireless Big-Data/Analytics, Cloud computing, Security/Encryption, Data visualization and Virtualization/Simulation technologies as shown in the figure below. There is also a high adoption of sensor, and automation technologies.

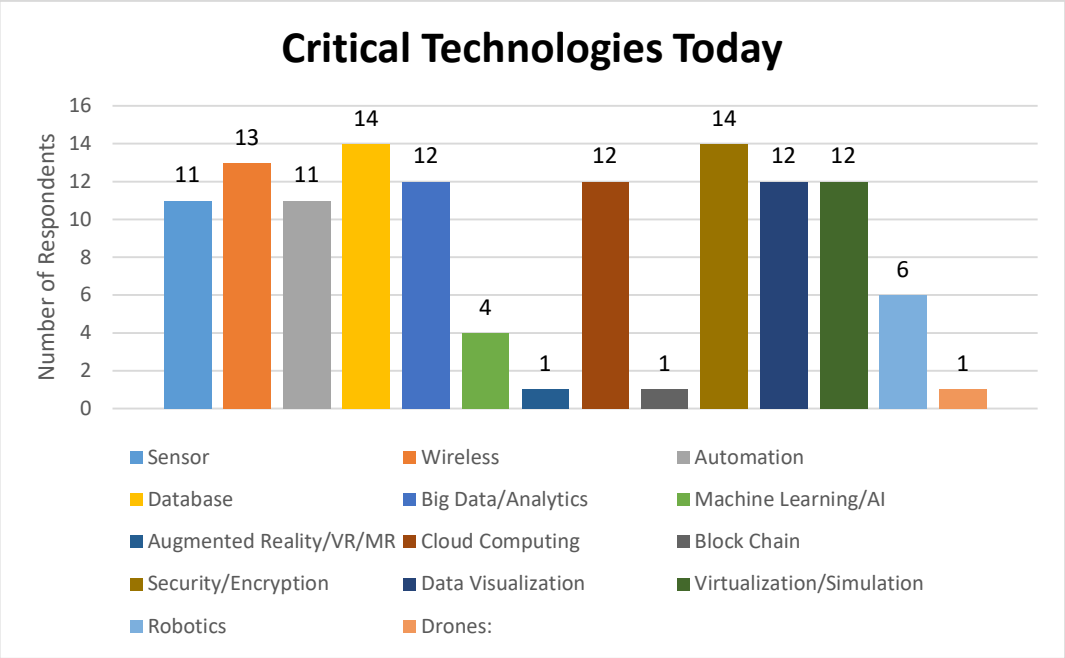

Figure IV.31 Current Critical Technologies in Poland

Very few of the respondents adopt Machine-Learning/AI, Augmented Reality/VR/MR, Block Chain, Robotics and Drone technologies. The adoption of digital technologies by the respondent is high.

What are your strongest areas?

The core areas of service provision of each respondent are represented in the table below.

Table IV.12 Areas of strong focus of the respondents from Polish Industry

Respondents	Area of strong focus
1	Database technologies
2	Automation, portable computer technologies and sensor technologies
3	Sensors, Wireless, Automation, Data Encryption., Data virtualization and Robotics.
4	Automation Technologies, Large Data Sets.
5	Machine learning for image recognition and decision support
6	Technologies partly used: Machine Learning/AI Technologies used in production: Automation & Robotics.
7	Specialize in wireless communication
8	The company has the largest experience in the field of digital technologies related to data visualization.
9	Data visualization and Virtualization / simulation
10	Sensor [e.g. in the control of ovens], Database technologies
11	Data visualization and Database technologies
12	Big Data/Analytics & Cloud computing used in the Internet TV system, sensor
13	Counters used by the company use these technologies. Data transfer is carried out using wireless technologies and Data security/encryption
14	Company develop cash registers
15	Broadband Internet and dedicated solutions for television

Some of the respondents deliver the digital technologies as a solution, while others use these technologies to enable the digitization of their products.

How do plan to improve your competitiveness in digitalization?

Different companies have adopt different strategies towards becoming more competitive via the adoption of digital technologies. These plans are presented in the table below.

Table IV.13 Plans by Polish Industry to improve competitiveness in Digitization

Respondents	Areas to improve
1	❖ Employee competence development.
2	❖ Plans to: o Deploy augmented reality for cash registers. o Deliver Sensor technologies, Wireless technologies (Bluetooth, Bluetooth low energy, GSM, LTE), Big Data. o Own cloud systems, Data encryption. o Adoption of Data virtualization, Robotics.
3	❖ Employee competence development. ❖ Increased investment in infrastructure. ❖ Plans to develop the R & D department locally in Poland
4	❖ Work on being part of future growth of the value of cloud data from cash registers.
5, 6, 7	❖ The company plans to improve its competitiveness in the area of digitization.
9	❖ The development of GSM 2-5G Power grid and power industry Protocols & analysis
10	❖ Plans to implement: Wireless, in new devices (Bluetooth control of kettle or transferring to the mobile application the value of body fat) ❖ Automation - in the production of a kitchen robot, Virtualization / Simulation
13	❖ Ensuring Data security through encryption.
14	❖ Technologies associated with virtualization have a special meaning for the company.
15	❖ Technologies in the area of data security, databases and wireless technologies.

These plans are to either develop Human Resource development, infrastructure development, research and development or enhance service and production processes using digital technologies. Three respondents, respondents 8, 11 and 12 do not have to plans towards becoming more competitive in a digitalized industry.

2. Do you have a digital strategy and/or an operational plan for its implementation and what is the period? Please provide a short definition of your digital strategy.

Very few (4) respondents had a documented digital strategy. Most of the respondents did not see the need for documented digital strategies. This was because most of the respondents had unwritten embedded digital strategies in their operational activities. For some of the respondents, their operational strategy was digital-by-default. In other cases their embedded digital strategy was driven by either user needs; changes in technology used in the industry; the need to ensure data and device security, or the adoption of first mover's advantage in the adoption of new digital technologies.

How could digital disruption scenarios look in your business?

Response gathered indicates that the companies interviewed can be divided into two camps on the issue of digital disruption. The first camp is made up of companies who see digital disruption as an opportunity to evolve and innovate. These companies anticipate, expect and prepare for these disruptions. The second camp consist of companies who identify digital disruption as a risk. Risks identifies include financial risks, emerging regulatory risks, the risk of a competitive innovation from other competitors, the rapid growth of the market by which they operate, and data and devise bridge security risks. These are companies who do not have the resources to combat these risks, hence they watch out and try to avoid operating in a manner where they will be exposed to these risks.

What will change?

The respondents agreed that digitization could result in changes within the industry they operate. These could be positive or negative changes. Some of the partners did reflect on how they think digitization will affect their business. Seven of the respondents did not foresee evolved digitization resulting in negative changes to their business. This is because, as mentioned earlier, they saw the evolution in the digital technologies as an opportunity to innovate. However, six of the respondents foresaw digitization driven changes, which might affect their industry. These changes include:

- Potential threats to the loss of a part of the market if these changes take place too quickly.
- Changing demand towards advance services because of digitization.
- The continuous evolution of communication devices to more M2M connectivity.
- Societal evolution due to a digitally enabled society.
- Abrupt product changes by manufacturers of products.
- Constant changes in technology (mentioned by two respondents).

One more respondent adopted a different approach to identify what needs to be done to create change. The respondent identified the need for the deregulation of the industry to reduce market entry barriers. This would obviously promote competition as well as enable the delivery of innovative digital products and services.

What will stay the same?

Only one respondent did not see a change in their industry. The respondent is a manufacturer of measuring instruments.

What would be your company's role and target position?

Six companies indicated that they have plans to influence change in digitization of their respective industry in Poland. These plans include:

- The digitalization of their operational and production processes.
- The expansion in the automation of the operational and production processes
- Being the source of change in the digital evolution of their operational and production processes.
- The evaluation and stocktaking of the existing changes and the mapping of strategies on how to adapt to such changes.

- Proactively embracing digitization.
- Forging partnerships with relevant companies such as telecom companies to develop the latest technology.

3. Could you implement digital solutions by yourself in your organization or do you need help from other companies/partners in a cross-sectoral collaboration, especially with ICT?

Three approaches to digital implementation were identified from the responses from the companies. These were the hybrid approach, outsourcing and the independent implementation approach. The hybrid approach is a combination of independent implementation and outsourcing to third party partners.

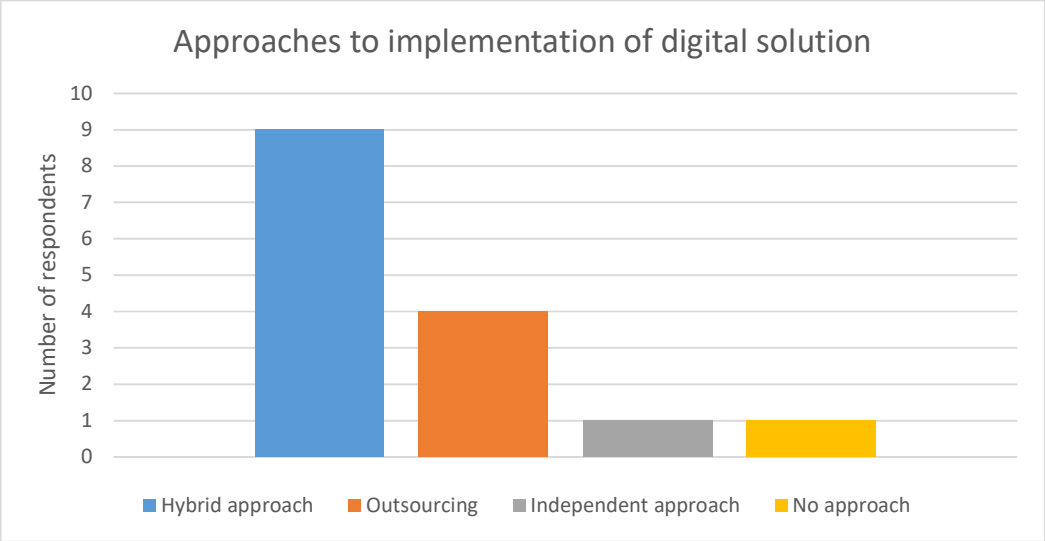

Figure IV.32 Approaches to implementation of digital solutions by Polish Industry respondents.

The companies that adopted the independent implementation approach are those with financial, human, technological and market resources that supports this approach. As seen in figure IV.32, only one respondent could afford the independent approach. Companies that lacked some of the needed resources to develop a product or service resorted to the hybrid approach. The hybrid approach involved the company developing some aspects of their services independently and other aspects via. Outsourcing. As seen in the figure above, the hybrid approach was the most popular approach, adopted by 9 of the 15 respondents. This is because this approach enables the SMEs to leverage competences and resources between partners in the service development process. Companies that lacked the requisite resources to develop a particular product or service resorted to outsourcing. Four of the respondents resorted to outsourcing. Based on the response pattern, most of the respondents lack the capacity to develop their develop digital solutions digitally.

Have you established any such (new) contacts or relations?

The partners that adopt either the hybrid approach toward implementing digital solution or outsourcing collaborate with Polish and international partners. These are either technology or

supplier partners, such as telecommunication operators, manufacturer of GSM module and manufacturers of electronic systems. One respondents collaborates with Higher education institutions.

Polish and foreign technology partners; Polish and foreign suppliers; Google, Oracle and Microsoft, IBM, polytechnics and national universities

Where are they located?

The foreign partners of the respondents are from the United States, Sweden, Denmark and China, EMEA region. Some of these partners include IBM, Microsoft, Oracle and Google.

4. Which digital disciplines do you need in your business to implement your digital strategy?

Competences in database, wireless, automation, Big Data/Analytics, cloud computing and security/encryption technologies are in high demand for the respondents as seen in the figure below.

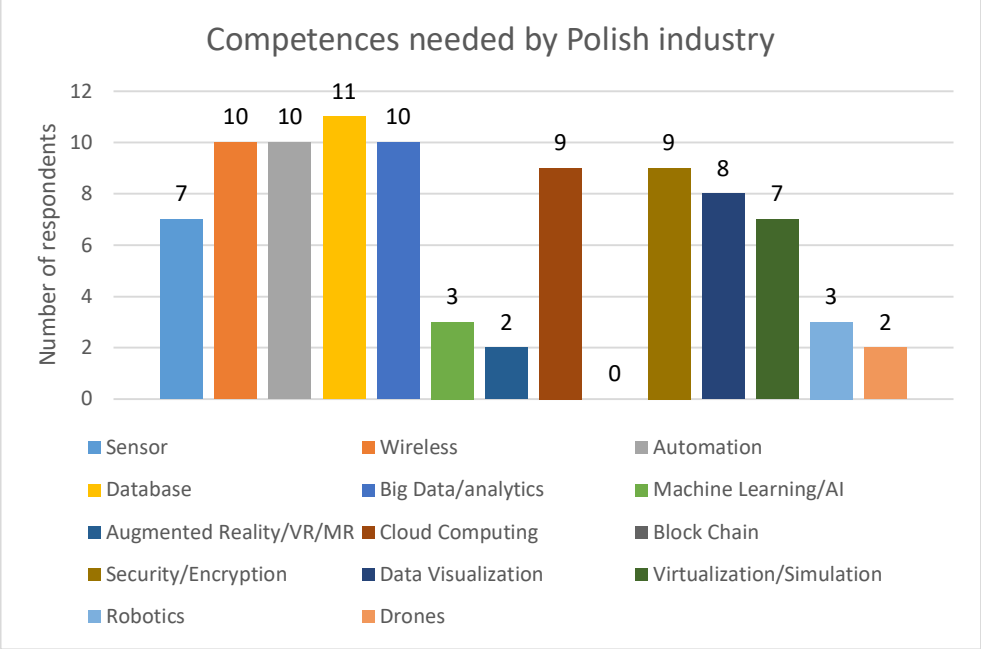

Figure IV.33 Competences required by Polish industry

Some of the respondents require competences in sensor technologies, data visualization and virtualization/simulation technologies. As very few of the respondents utilize drones, robotics, augmented reality/VR/MR and machine learning technologies, the need for competences in these technologies is less.

5. Which of your products/services are, to some extent, based on the current state of digital technology. How many products/services in percentage?

Approximately half of the respondents use digital technologies in the delivery of all of their products and services as shown in figure IV.34 below. Almost of the respondents use digital technologies in the delivery of at least 4% of their products.

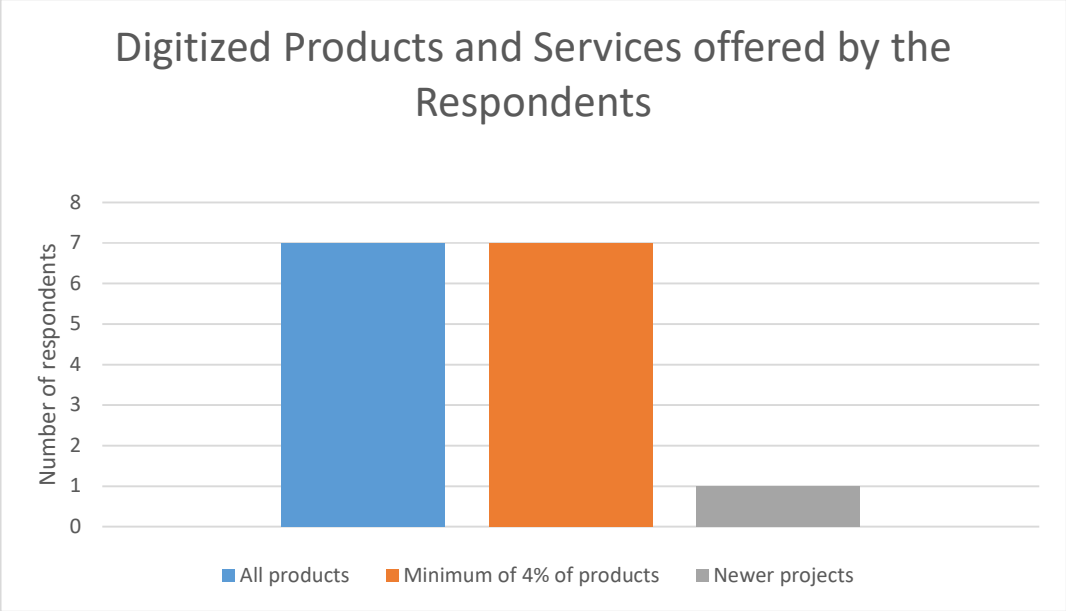

Figure IV.34 Number of products and services digitized by Danish Industry

Within that category, one of the respondents use digital technologies in the delivery of almost 80 percent of their services. One respondent use digital technologies in the delivery of newer projects. The general responses from most of these companies indicate that they will be digitalizing more of their products. The indication is based on the fact that their strong areas are tilted towards digital products. Furthermore, the competences they require are those needed for the delivery and support of ICT based technologies that support home, industrial and societal usage. Hence, there is potential for growth in the delivery of the digital products and services for these companies.

6. Have you activated or started any plan or activities for your organization to acquire digital awareness or knowledge?

Every respondent had at least one existing activity aimed at the creation of digital awareness in his or her organization. There strategies can be grouped into three levels. These are the organizational, unit and individual levels.

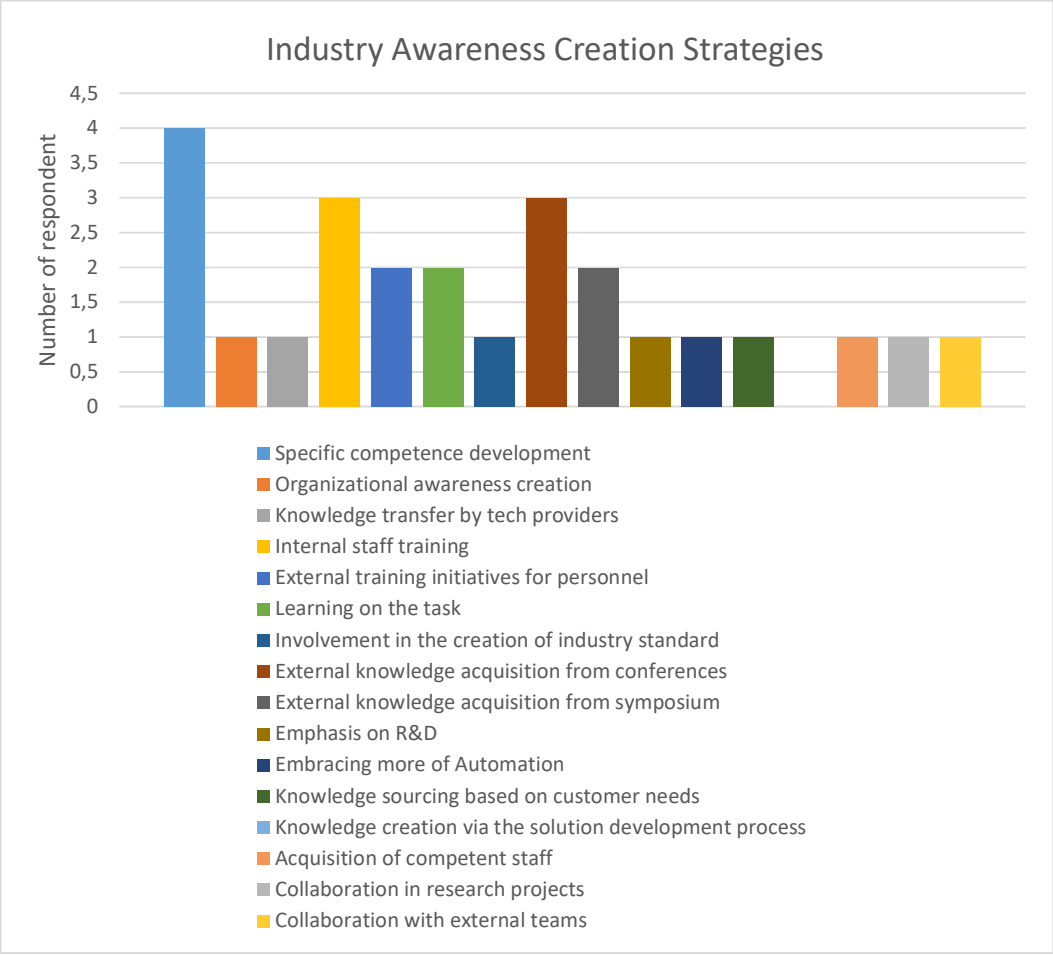

Figure IV.35 Awareness creation strategies by Polish industry respondents.

At the organizational level, one of the respondent facilitates competence acquisition and the awareness of digital technologies to all members in the organization. This is part of their overall company development strategy.

Other respondents tailored awareness to necessary units within the organization. Such units could be either production, marketing, operations etc. Awareness creation at this level was via internal staff training; external training initiatives for personnel; the focus on research and development; external knowledge acquisition from conferences and symposiums; knowledge transfer from technology providers; collaboration in research projects; collaboration with external teams; knowledge sourcing from customers and knowledge creation through the solution development process. The type or nature of awareness creation strategy depends greatly on the importance of the unit to revenue generation; the competitive advantage provided through digitalization; knowledge needs for the digitalization process and the company's digitization strategy.

At the individual level, the respondents identified two approaches. There were individually led capacity building initiatives and the organization led capacity-building initiative. For the individually led initiative, the individual builds capacity by himself/herself and is employed to create value to the company. In the company led initiative, the company adopts new initiatives

such as embracing more of automation and initiation of projects by which the individual will develop capacity on the task.

The activities at the organizational, and unit level to contribute to awareness creation at the individual level and vice versa.

IV.7.3. Summary

The Polish companies are advanced in the adoption of most of the digital technologies. The average scale indicating the importance of these technologies today, for the quantitative interview was 3,1. These companies adopt both communication technologies and data driven technologies. The respondents expect all the technologies except, drones, Block Chain, Augmented Reality and Machine Learning technologies to be critical in the next 5 years. Some of the respondents operate in collaboration with local and global partners to deliver their solution. Very few of them possess a documented digital strategy and their major challenge is the lack of IT infrastructure, followed by the lack of physical infrastructure and access to workforce. These are challenges that could be solved by facilitation policies and initiatives aimed at infrastructure development and an educational policy.

Section V. Conclusions

It comes out from the analyses that there is general openness to the adoption of new digital technologies in the partner countries, and that the level of adoption of the technologies despite some differences between the countries is at a similar level.

The following, currently used technologies are rated similarly and above the average - 2.9 on the 5 step scale (cf section II.3) with respect to importance: Automation; Databases; Wireless; Security/ Encryption; Cloud Computing; Data Visualization; Sensors; Virtual Simulation.

Other technologies such as Robotics; Big Data; AI/ Machine Learning; Augmented Reality; Block Chains; Drones and especially the four last are on/ below the average in importance. The reasons for the low adoption of these technologies are: high cost of deployment; absence of clear revenue streams; and fewer use case scenarios for the utilization of the technology. Further it is also resulting from the lack of perceived value of this technology to products, and deficiency of service development processes by the majority of operators. The adoption is of a technology is generally driven by either the ability of the technology to support operational processes or product/service development.

For the future take-up of technologies, a fundamental shift is not foreseen in the next 5 years. These projections were not a result of a nonchalant attitude to the future. Rather it was cautious optimism that things will remain the same; hence, there is a positive approach towards the adoption of more of Automation, Databases, Wireless, Security/encryption, Cloud Computing, Data Visualization, sensors, virtual simulation, Robotics and Big Data. However, AI/machine learning, Augmented Reality, Block Chain and Drones are technologies that will be used to a lesser extent in the BSR

It should be noted that the above results are based on responses to the DIGINNO surveys, not comprehensive national surveys. However, national experts have validated the results as giving fair impressions of the situation in the countries.

With respect to the influence of the general environment on digitalization some common problems were identified

- Access to workforce/shortage of labor force.
- Need for upgrade of infrastructure
- Need for upgrade of networking
- Regulation
- Lack of financial instruments
- Taxation – this is, however, seen as general economic policy and outside the scope of the project

Further, two issues have been identified a) it was evident that most respondents do not have a documented organizational digital strategy; b) there is the desire to adopt more technologies but there is a lack of competence in the BSR.

This leads to two sets of recommendations

a) for further project actions
b) for policy actions

a. Project actions

It is suggested to arrange Delphi-type workshops in Estonia, Latvia, Lithuania & Poland. This activity shall further validate the survey results and specifically clarify the problems associated with

1) Need for upgrade of infrastructure
- Need for upgrade of networking
- Regulation
- Lack of financial instruments

and ultimately strengthen the suggested general policy actions.

b. Policy actions

The project focus is on SMEs and it has been identified that they are facing similar challenges related to take-up of digital technologies, so there is a potential in BSR collaboration with attention specifically to

- The identification of drivers to realize the expected higher penetration of already deployed technologies
- The identification of potentials for deploying low rated technologies
- The need for education programs to realize the above
- The need for awareness raising – to realize the three bullets above

There are several examples of positive impact from specific actions illustrating potentials in learning and collaborating in policy collaboration across BSR:

- Swedish companies with documented organizational digital strategies are especially successful
- In Latvia, there is an ongoing, successful dialogue between the vocational education sector and industry on the development of competence needed by industry.
- In Denmark, creation of ICT industry/ university networks has promoted industry/ product development

Section VI Appendices

Appendix VI.1. The technologies selected for the BNA

DT1) Sensor technologies

A sensor is a device that detects and responds to input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena. The output is generally a signal that is either converted to a human-readable display at the sensor location or transmitted electronically over a network for reading or further processing.

DT2) Wireless Technologies

Transfer of power/ signals between two or more points not connected by an electrical conductor. The most common wireless technologies use radio waves. With radio waves, distances can be short, such as a few meters for Bluetooth or as far as millions of kilometers for deep-space radio communications. It encompasses various types of fixed, mobile, and portable applications, including two-way radios, cellular telephones, personal digital assistants (PDAs), and wireless networking.

Other examples of applications of radio *wireless technology* include GPS units, garage door openers, wireless computer mice, keyboards and headsets, headphones, radio receivers, satellite television, broadcast television and cordless telephones.

DT3) Automation Technologies

A process or procedure which is performed without human assistance. Automation or automatic control is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other applications and vehicles with minimal or reduced human intervention. Some processes have been automated completely.

DT4) Database technologies

An organized collection of data, stored and accessed electronically. Database designers typically organize the data to model aspects of reality in a way that supports processes requiring information, such as modelling the availability of rooms in hotels in a way that supports finding a hotel with vacancies.

DT5) Big Data/Analytics

Big data is data sets that are so voluminous and complex that traditional data-processing application software are inadequate to deal with them.

Big data challenges include capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating, information privacy. Data analysis is a process of inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, informing conclusions, and supporting decision-making. Data analysis has multiple facets and approaches, encompassing diverse techniques under a variety of names, while being used in different business, science, and social science domains.

DT6) Machine Learning/Artificial Intelligence

"Intelligence" demonstrated by machines, in contrast to the natural intelligence (NI) displayed by humans and animals. In computer science, AI research is defined as the study of "intelligent agents": any device that registers its environment and takes actions that maximize its chance of successfully achieving its goals. Colloquially, the term "artificial intelligence" is applied when a machine mimics "cognitive" functions that humans associate with other human minds, such as "learning" and "problem solving".

DT7) Augmented Reality /Virtual Reality/Mixed Reality

AR is an interactive experience of a real-world environment whose elements are "augmented" by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory, and olfactory. The overlaid sensory information can be constructive (i.e. additive to the natural environment) or destructive (i.e. masking of the natural environment) and is seamlessly interwoven with the physical world such that it is perceived as an immersive aspect of the real environment. In this way, augmented reality alters one's ongoing perception of a real world environment, whereas virtual reality completely replaces the user's real world environment with a simulated one. Mixed reality (MR), sometimes referred to as hybrid reality, is the merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real time. Mixed reality takes place not only in the physical world or the virtual world, but is a mix of reality and virtual reality, encompassing both augmented reality and augmented virtuality via immersive technology.

DT8) Cloud computing

Is an information technology (IT) paradigm that enables ubiquitous access to shared pools of configurable system resources and higher-level services that can be rapidly provisioned with minimal management effort, often over the Internet. Cloud computing relies on sharing of resources to achieve coherence and economies of scale, similar to a public utility.

DT9) Block Chain

A continuously growing list of records, called *blocks*, which are linked and secured using cryptography. Each block typically contains a cryptographic hash of the previous block, a timestamp, and transaction data. By design, a block chain is resistant to modification of the data. It is an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way. For use as a distributed ledger, a block chain is typically managed by a peer-to-peer network collectively adhering to a protocol for inter-node communication and validating new blocks. Once recorded, the data in any given block cannot be

altered retroactively without alteration of all subsequent blocks, which requires consensus of the network participants.

DT10) Security/encryption

IT security is the protection of computer systems from theft of or damage to their hardware, software or electronic data, as well as from disruption or misdirection of the services they provide. Encryption is the process of encoding a message or information in such a way that only authorized parties can access it and those who are not authorized cannot. Encryption does not itself prevent interference, but denies the intelligible content to a would-be interceptor.

DT11) Data visualization

To communicate information clearly and efficiently, data visualization uses statistical graphics, plots, information graphics and other tools. Numerical data may be encoded using dots, lines, or bars, to visually communicate a quantitative message.

DT12) Virtualization/simulation

Virtualization refers to the act of creating a virtual (rather than actual) version of something, including virtual computer hardware platforms, storage devices, and computer network resources.
Simulation is the imitation of the operation of a real-world process or system. The act of simulating something first requires that a model to is developed; this model represents the key characteristics, behaviors and functions of the selected physical or abstract system or process. The model represents the system itself, whereas the simulation represents the operation of the system over time.

DT13) Robotics

An interdisciplinary branch of engineering and science that includes mechanical engineering, electronics engineering, computer science, and others. Robotics deals with the design, construction, operation, and use of robots, as well as computer systems for their control, sensory feedback, and information processing. These technologies are used to develop machines that can substitute for humans and replicate human actions.

DT14) Drones

Remotely controlled or autonomous aircrafts with no pilot on board. Also called *unmanned airc raft system*.

Appendix 2. Survey Questions

1) What is the level of digitalization in your business on a scale from 1 (very low) to 5 (very high)?

Importance

Today	___	1	2	3	4	5
2 years from now	___	1	2	3	4	5
5 years from now	___	1	2	3	4	5

2) Which of the following digital technologies (DT1 to DT14, Appendix 1) do you use in your business today? How important are they to your business? (1 = not at all important … 5 = very important/critical)

Importance						
Sensor technologies	___	1	2	3	4	5
Wireless technologies	___	1	2	3	4	5
Automation technologies	___	1	2	3	4	5
Database (Data Acquiring) technologies	___	1	2	3	4	5
Big data/analytics	___	1	2	3	4	5
Machine Learning/Artificial Intelligence	___	1	2	3	4	5
Augmented Reality /Virtual Reality/Mixed Reality	___	1	2	3	4	5
Cloud computing	___	1	2	3	4	5
Block chain	___	1	2	3	4	5
Security/encryption	___	1	2	3	4	5
Data visualization	___	1	2	3	4	5
Virtualization/simulation	___	1	2	3	4	5

Robotics	___	1	2	3	4	5
Drones	___	1	2	3	4	5
Others, please specify	___	1	2	3	4	5

3) Which of the following digital technologies (DT1 to DT14 in Appendix 1) do you think you will use in your business in 5 (five) years? How important will they be to your business? (1 = not at all important … 5 = very important/critical)

Importance

Sensor technologies	___	1	2	3	4	5
Wireless technologies	___	1	2	3	4	5
Automation technologies	___	1	2	3	4	5
Database (Data Acquiring) technologies	___	1	2	3	4	5
Big data/analytics	___	1	2	3	4	5
Machine Learning/Artificial Intelligence	___	1	2	3	4	5
Augmented Reality /Virtual Reality/Mixed Reality	___	1	2	3	4	5
Cloud computing	___	1	2	3	4	5
Block chain	___	1	2	3	4	5
Security/encryption	___	1	2	3	4	5
Data visualization	___	1	2	3	4	5
Virtualization/simulation	___	1	2	3	4	5
Robotics	___	1	2	3	4	5
Drones	___	1	2	3	4	5

Others, please specify ___ 1 2 3 4 5

4) To which degree do you think that new business possibilities will replace your existing ones?

1: Not at all 3: Medium 5: All will be disrupted

5) To which degree do you think that competition will increase/decrease in your business area due to digitalization?:

1: Competition will disappear 2: 50% of competitors will disappear 3: As now 4: Increase by 50% 5: Increase by 100%

6) How likely is it that you will get new customers in other EU countries to your new digital business?:

1: Very unlikely 2: Unlikely 3: Possible 4: A good chance 5: Most certain

7) How likely is it that there will be new partners in the implementation of new digital solutions in your businesses?:

1: Very unlikely 2: Unlikely 3: Possible 4: A good chance 5: Most certain

8) Where will you position the new digital possibilities in your business area as a driver on a scale from 1:'Supporting existing business' to 5:'Creating new business areas'?

An example of the difference between existing business and new business areas: The development of digital technologies may disrupt existing businesses, but it also opens up for new business areas/possibilities. An historical example of new business possibilities could be, that GPS satellite technologies together with small powerful computers, electronic maps and user-friendly voice controlled Man Machine Interface design gave us the wonderful car navigator. Later this now existing business more or less was disrupted by the integration of navigation in smart phones.

1: 100% Supporting existing businesses 2: 20%/80% 3: 50%/50% 4: 80%/20% 5: 100% New business areas

9) How much will digitalization affect your business in 2 years? from 1 (not at all) to 5 (very much)?

10) How supportive is the overall business environment for digitalization of companies in your country and in your business sector? (1 = not at all supportive … 5 = very supportive

Importance of environment component

Regulatory framework and legislation	1	2	3	4	5
Taxation	1	2	3	4	5
Physical infrastructure	1	2	3	4	5
IT infrastructure	1	2	3	4	5
Awareness raising activities	1	2	3	4	5
Networking activities	1	2	3	4	5
Financial instruments	1	2	3	4	5
Access to competent workforce	1	2	3	4	5

Appendix VI.2. 'Check- guide' for Interviews

1) Which digital technologies (DT1 to DT14, page 7-9) do you use today in your business, and how would you evaluate your company's ability and readiness to leverage digitalization in comparison with your (current and future) partners, customers and competitors?

What are your strongest areas?

How do plan to improve your competitiveness in digitalization?

2) Do you have a digital strategy and/or an operational plan for its implementation and what is the period? Please provide a short definition of your digital strategy.

How could digital disruption scenarios look in your business?

What will change?

What will stay the same?

What is sure to happen?

What will not happen?

What changes are you afraid of?

What changes do you hope for?

What would be your company's role and target position?

(this is an open-ended question, but the interviewers can use the supportive questions a) to help the interviewee and b) to structure the interview and the answers in a meaningful way)

3) Could you implement digital solutions by yourself in your organization or do you need help from other companies/partners in a cross-sectoral collaboration, especially with ICT?

Have you established any such (new) contacts or relations?

Where are they located?

Which countries and partners?

4) Which digital disciplines do you need in your business to implement your digital strategy?

5) Which of your products/services are, to some extent, based on the current state of digital technology**.** How many products/services in percentage?

6) Have you activated or started any plan or activities for your organization to acquire digital awareness or knowledge?

What kind of actions have you undertaken in order to implement it?