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Industry 4.0 and Greek Enterprises before Economic Crisis: A Preliminary Research

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Abstract

Nowadays, in the era of 4th Industrial Revolution, businesses have to face many challenges. The purpose of this study is to identify the readiness level of Greek businesses to face the challenges of Industry 4.0. A questionnaire survey was conducted to Greek business operating in various industries. The paper contributes to identify whether businesses take into consideration various aspects of Industry 4.0, if they are willing to adopt new digital technologies and the kind of difficulties that they face. This study covers the time period from before the economic crisis, and it is proposed that a new survey should be conducted considering the addressed topics regarding the current economic situation.

Keywords

Industry 4.0, Industry 5.0, Digital Transformation, Greek Enterprises

1. Introduction

Nowadays economic development, to a very large extent, depends on scientific and technological progress (Devezas et al., 2018). The term 4th Industrial Revolution (Industry 4.0/4IR) is an "umbrella" term that sums up a set of technological transformations that have been happening at an extraordinary rate for the last decade. 4IR has impacts on business, government and people (Schwab, 2016), bringing to the fore a series of social, political, cultural and economic developments (Schwab, 2021). Industry 4.0 changes the way people live and work and it is not just about technology.

Emerging technologies, the amount of data that is being produced, stored and processed all give new possibilities to productive process in industries and activities of all sectors of economy, by also providing an opportunity for new business

models (Kagermann et al., 2013). According to PwC's eight technologies, in the era of 4IR, shape the future of business: artificial intelligence, 3-D printing, augmented reality, internet of things, blockchain, robotics, virtual reality, drones (PwC, 2022).

Hellenic Federation of Enterprises (SEV) and Deloitte develop a Digital Transformation Observatory of the Greek business and economy so to promote digital transformation of Greece. According to a primary survey that was conducted in February 2019, while investments in Information and Communication Technology (ICT) both of private and public sectors, are at relatively high levels, the digital maturity of companies and the government in Greece is low, which may point out the absence of a clear digital strategy in the majority of Greek companies (Deloitte & SEV, 2019). Nevertheless, due to COVID-19 crisis many Greek businesses adopted strategies concerning digital transformation trying to adapt to the new conditions (EKT, 2021). On the other hand, EU is already adopting an Industry 5.0 program as a tool to transform its economy (EU, 2022).

The aim of this research is to detect if Greek businesses are ready to adopt new technologies so as to face the challenges of Industry 4.0. It should be pointed out that the research concerns the time period before the outbreak of the economic crisis and could be used in the future to investigate whether the measures taken are heading towards the right direction. The article is organized as follows. In Section 2, a literature review on Industry 4.0 is presented. This is followed by a description of the methodology and analysis of selected data. In Section 4, the proposed approach is discussed for future research, besides the limitations of the study.

2. Literature Review

The term "Industrie 4.0" is first introduced in 2011 at industrial trade fair Hannover Messe, as a strategy to transform manufacturing, with the Platt form Industrie 4.0 (plattform-i40.de) making a decisive contribution to this direction (WWW.BMWK.DE, 2022). Despite the popularity of the term, a systematic approach could not be found (Klingenberg et al., 2022; Pfeiffer, 2017; Rüttimann & Stöckli, 2016). The aforementioned term, often describes a high-tech-strategy that is driven from IT changes not only in manufacturing systems, but now a days IT changes that affect the organization as a whole, and is associated with the so-called 4IR (Lasi et al., 2014; Tupa & Steiner, 2019). The term often includes a variety of concepts like Smart Factory, Cyber-physical Systems, New systems in distribution and procurement, Self-organization New systems in the development of products and services, Corporate Social Responsibility, Adaptation to human need (Lasi et al., 2014). Furthermore, the 4IR aims to meet the needs of society, transforming society, having effects on business (Asadollahi-Yazdi et al., 2020; Groumpos, 2021; Wójcicki et al., 2022; World Economic Forum, 2016). Muler et al. give a comprehensive literature review findings about term Industry 4.0 (Müller et al., 2018).

Before making a detailed reference to the term 4IR, some key points about previous "industrial revolutions" should be noted. 1st IR is characterized of the mechanization of the production using energy from steam.The 2nd IR is associated with electricity and the first internal combustion engines, discoveries that gave a huge boost to industrial production and brought great changes to humanity. The 3rd IR is associated with the automation of production, the use of computers in the production process, the digitization of services (Basl, 2017; Klingenberg et al., 2022).

From a multidisciplinary point of view, key technologies in the era of Industry 4.0 are cyber physical systems (CPS), embedded systems, sensors, Big Data Internet of things (IoT), cloud manufacturing, Radio Frequency Identification (RFID), automation, robots, additive manufacturing, virtual reality (VR), augmented reality, data mining, advanced, Blockchain, cloud computing, 3D printing, smart materials, artificial intelligence (AI), machine learning (ML), cyber security, Machine-to-Machine (M2M) communication (Tsaramirsis et al., 2022; Wichmann et al., 2019).

Some key technology trends in implementing Industry 4.0 are presented below: IoT and related technologies (e.g. radio-frequency identification technology, Global Positioning System, mobile devices), cloud computing, Cyber-physical systems, Artificial Intelligence, Material requirements planning, Machine learning, Computer networks, cyber security, Environmental control systems, Computer-aided manufacturing, Databases, big data, robotics, Wireless communication, Embedded systems Flexible manufacturing systems (WMG, n.d.; Xu et al., 2018).

Main goal of Industry 4.0 is the production of systems that are flexible, adaptable to changes and able to respond to disruptions, affecting value chain providing new services and product-service systems, connecting machines, methods, and products (Crnjac et al., 2017; Komakech et al., 2021; Müller et al., 2018), by integrating innovative technologies (e.g. advanced control systems) combined with Information Technologies (e.g. IoT), so as to enable communication between people, products and systems, obtaining data in real time (Kendirli & Berksun, 2020; Kunrath et al., 2023; Sreedhara, 2020). It is noteworthy that in many cases the word that is used to describe the extended use of electronic devices to aggregate data from sensors through networks is "smart" (Lee et al., 2017).

A framework of interoperability of Industry 4.0 may include smart factory and manufacturing, smart product, smart building, smart home, smart facility, smart transportation, smart grid, smart city (Lu, 2017). Furthermore, one of the key requirements is integration, but it must be pointed out that until now many issues concerning production systems or organizational and managerial issues are still under investigation (Agostini & Filippini, 2019; Burns et al., 2019). A survey in 2020 revealed that the main obstacles that businesses must overcome towards digital transformation are: organizational problems, financial and technological

barriers (McKinsey, 2022).

European Commission introduces Industry 5.0 approach as a transformative model in a broader context, connecting digital transformation with sustainability and climate action (EU, 2022). Potential applications of Industry 5.0 are intelligent healthcare, cloud manufacturing, supply chain management, education, human cyber physical systems, disaster management uses various enabling technologies are edge computing, digital twins, cobots (collaborative robots), Internet of everything, Big data analytics, Blockchain, 6G and beyond, Network Slicing (NS), eXtended Reality (XR), and Private Mobile Network (PMN) (Maddikunta et al., 2022). Research definitions/approaches on the term Industry 5.0 are given below (**Table 1**).

However, the implementation of Industry 4.0 solutions in Greek enterprises has not fully been investigated. The study would help managers to adopt strategies that predominate obstacles towards 4IR. The research aims to identify which is the level of digital maturity of Greek businesses. Furthermore, which are the main barriers to 4IR adoption.

3. Methodology and Results

In order to investigate whether Greek companies adopt digital technologies, a survey was conducted in various Lines of Business. The questionnaire included 32 questions of various types (e.g., Likert scale, multiple choice, open-ended questions, demographic questions). The Likert scale questions are five-point scale, Questionnaires were sent by email and all collected information (the period from June to November 2019) has been analyzed in aggregate.

As the nature of the research was exploratory, the authors choose as sampling technique the purposive or judgmental sampling. The completed questionnaires concern companies from different sectors of the economy. Although the specific technique cannot be used to the generalization of research findings, nevertheless one can get a general idea regarding the adoption of digital technologies by Greek companies and the inhibiting factors in this direction. The results of the study are presented below.

Data Analysis

In this study, 50 questionnaires were analyzed. The respondents' profile is given in **Table 2**. Among the 50 total respondents, 46 (92%) were men and 4 (8%) were women. Regarding age, 5 (10%) of the respondents were 26 - 35 years old, 16 (32%) were 36 - 45, 24 (48%) were 46 - 55 and 5 (10%) were over 56 years old. Moreover, 2 (4%) of the total respondents had a PhD, 38 (76%) had a master's degree, 8 (16%) had a third-grade education, while the rest 2 (4%) had a second-grade education. Finally, 30 (60%) respondents had a high level of position within the company, 18 (36%) had a middle level of position and only 2 (4%) of the total respondents had a low level of position within the company.

Table 1. Definitions/approaches regarding Industry 5.0 concept.

Author(s), year	Definition/approach
(Demir et al., 2019)	"Two visions emerge for Industry 5.0. The first one is "human-robot co-working"; "Another vision for Industry 5.0 is bioeconomy"
(EU_DG for Research and Innovation, 2020)	"Industry 5.0 focus from shareholder to stakeholder value, with benefits for all concerned. Industry 5.0 attempts to capture the value of new technologies, providing prosperity beyond jobs and growth, while respecting planetary boundaries, and placing the wellbeing of the industry worker at the center of the production process."
(Longo et al., 2020)	"Industry 5.0 is compelling computer scientists, designers, industrial engineers, as well as philosophers and legal experts to concentrate on the means by which technologies within 5.0 industrial systems can be designed for human values, rather than relegating them as an afterthought"
(Xu et al., 2021)	"Industry 5.0 centers around three interconnected core values: human-centricity, sustainability and resilience"; "is not a technology-driven revolution but a value-driven initiative that drives technological transformation with a particular purpose"
(EU-DG for Research and Innovation et al., 2021)	"The concept of Industry 5.0 …highlights the importance of research and innovation to support industry in its long-term service to humanity within planetary boundaries"
(Adel, 2022)	"Industry 5.0 is the upcoming technology of the previous generation designed for efficient and intelligent machines."
(Grabowska et al., 2022)	"The symbiosis of three segments: technological, social and ecological, constitutes the essence of Industry 5.0"

Table 2. Demographic characteristics of interviewees.

Gender	
Male	46 (92%)
Female	4 (8%)
Age	
26 - 35	5 (10%)
36 - 45	16 (32%)
46 - 55	24 (48%)
56+	5 (10%)
Educational Level	
Second grade education	2 (4%)
Third grade education	8 (16%)
Master's degree	38 (76%)
PhD	2 (4%)

Continued

Level of position with the company	
High	30 (60%)
Middle	18 (36%)
Low	2 (4%)

Among the 50 organizations in total, 18 businesses (36%) were Greek companies operating in Greece, 23 (46%) were Greek and operated in several countries and 9 (18%) were a member of a multinational corporation. Regarding the industry, 10 (20%) of the companies operated in the retail & wholesale industry, 15 (30%) operated in the manufacturing industry, 5 (10%) were operated in the delivery & logistics industry and 9 (18%) companies provided health services. Moreover, 1 (2%) company provided accommodation services, 2 (4%) companies operated in the energy sector, 1 (2%) operated in the recycling & waste management industry, 2 (4%) operated in the construction & real estate industry, 4 (8%) in the I.T. technology & communication industry and 1 (2%) operated in finance & insurance industry.

Among the 50 companies, 25 (50%) were large-sized companies, 10 (20%) were medium-sized, 11 (22%) were small-sized and 4 (8%) were micro-sized companies. Finally, 36 (72%) companies operated for more than 25 years, 7 (14%) operated for 16 - 25 years, 6 (12%) operated for 6 - 15 years, while only 1 (2%) operated less than 5 years (**Table 3**).

Among the 50 respondents, 6 (12%) of them had a very high awareness of the term "Industry 4.0", 10 (20%) respondents demonstrated a high understanding of the term, 18 (36%) respondents showed an average knowledge about the term, 9 (18%) participants had low awareness of the concept of industry 4.0, while 7 (14%) of them showed a very low understanding (**Figure 1**).

Among the 50 companies, 3 (6%) of them had a very high level of readiness for taking advantage of the changes under industry 4.0, while 14 (28%) companies are ready at a higher level. Furthermore, 13 (26%) companies had an average level of readiness, 14 (28%) were ready at a low level, whereas 6 (12%) of the firms that responded in the survey answered that they had a very low level of readiness taking these advantages (**Figure 2**).

Regarding the level of digital transformation of production, 17 (34%) participants responded that digital technologies had already been incorporated in the production, 16 (32%) stated that certain digital technologies were being implemented but they had some flaws, while 5 (10%) responded that relevant issues were assessed. Moreover, 7 (14%) respondents claimed that digital transformation was in the company's interest, but no specific actions were taken and only 5 (10%) believed that digital transformation was not part of the company's goals (**Figure 3**).

The survey revealed that ERP systems were adopted by 45 (90%) companies, CRM was used by 26 (52%) of the firms, cloud computing was utilized by 24

Table 3. Business characteristics.

Countries of Operation	
Greek, and operates in Greece	18 (36%)
Greek, and operates in several countries	23 (46%)
Member of a multinational corporation	9 (18%)
Size	
Large	25 (50%)
Medium	10 (20%)
Small	11 (22%)
Micro	4 (8%)
Years of company's activity	
Less than 5 years	1 (2%)
6 - 15 years	6 (12%)
16 - 25 years	16 - 25 years
25 years or more	36 (72%)
Industry	
Retail & Wholesale	10 (20%)
Accommodation Services	1 (2%)
Manufacture	15 (30%)
Delivery & Logistics	5 (10%)
Health services	9 (18%)
Energy	2 (4%)
Recycling & Waste Management	1 (2%)
Construction & Real Estate	2 (4%)
I.T. Technology & Communication	4 (8%)
Finance & Insurance	1 (2%)

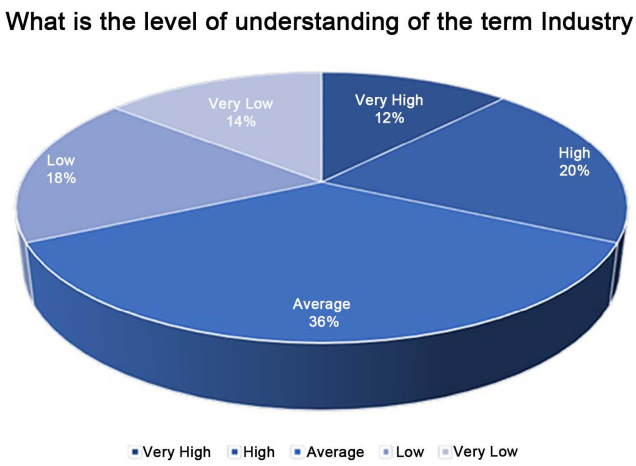
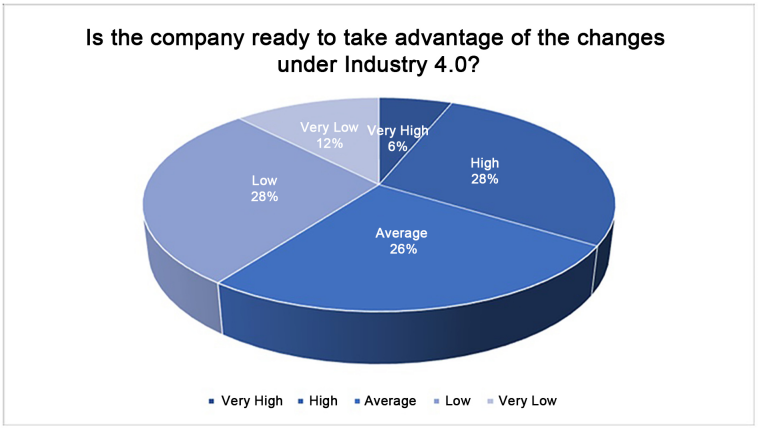


Figure 1. Level of understanding the term Industry 4.0. (created by the authors).



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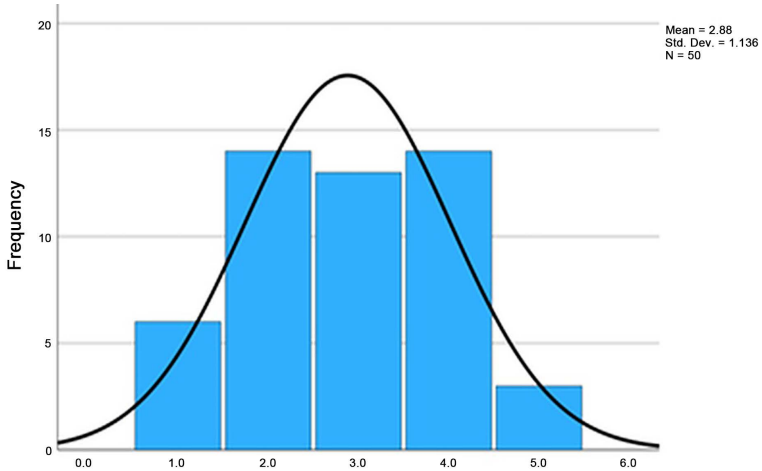

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Figure 2. Readiness for taking advantage of the changes under Industry 4.0. (created by the authors).

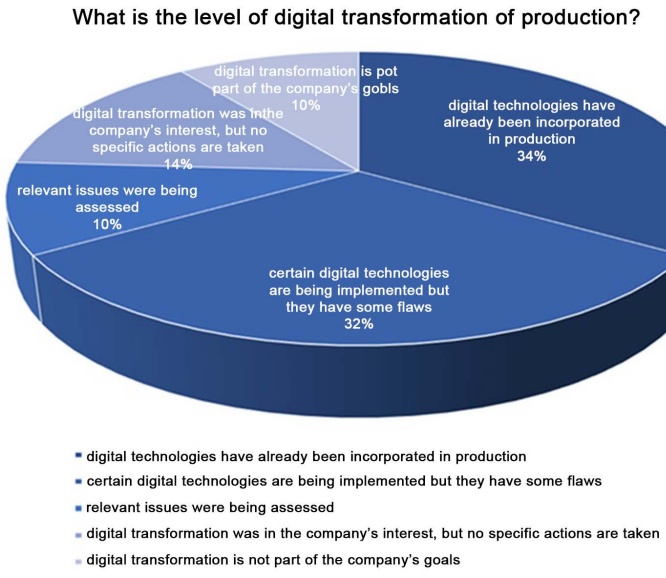


Figure 3. Level of production's digital transformation (created by the authors).

(48%), and mobile computing was used by 32 (64%) companies. Furthermore, sensors, RFID, PLCs & smart meters were adopted by 10 (20%) of the respondents, robotic automation systems were used by 9 (18%) companies, whereas big data management technologies were used by 13 (26%) firms. Only 3 (6%) companies took advantage of the 3D printing technology, while 17 (34%) organizations used technologies regarding risk management. Energy management technologies were utilized by 16 (32%) of the responding companies, only 2 (14%) were using blockchain, while 4 (8%) companies were using visual character recognition. Finally, 11 (22%) companies adopted enterprise collaboration platforms, whereas only one company responded that they used technologies for speech recognition (**Figure 4**).

In the question regarding the usage level of digital technologies in the company, 5 (10%) of the responding companies stated that they had a very high level of usage and 11 (22%) companies answered that they had a high level. Moreover, 21 (42%) of the companies believed that they had an average usage level of digital technologies, 9 (18%) participants stated that their companies had a low usage level, while 4 (8%) had a very poor usage level of these technologies (**Figure 5**).

16 (32%) companies would adopt new technological advancements due to competition, while the most common reason was the market requirements by 38 (76%) companies. Moreover, 6 (12%) claimed that customer pressure is one reason for adopting new technologies and 4 (8%) of the responding companies answered that supplier pressure was the reason. In addition, 14 (28%) claimed that compliance with regulations/legislations would be a significant reason for technological adoption, a number of 32 (64%) firms stated that they would use new technologies for economic reasons, while 28 (56%) believed that this type of adoption would be considered as good practices application. 15 (30%) answered that following the IT market trends is a reason for using new technologies, 22 (44%) of the responding companies would adopt new technological advancements because this practice is related to their business vision, while 10 (20%) stated that a good reason would be the efforts made by the employees to adapt to the changes (**Figure 6**).

Regarding the possible benefits for the company from exploiting Industry 4.0, the most common answer, that it was stated by 47 (94%) companies, was operation management, capacity, flexibility, and speed. 39 (78%) respondents believed that better customer service is one of the possible benefits, while 37 (74%) participants stated that cost reduction could be a benefit. Finally, automatization was answered by 32 (64%) participants, production and verification check was stated by 19 (38%) respondents, while 18 (36%) believed that product innovation could be a possible benefit for their company (**Figure 7**).

Most respondents (33% - 66%) stated that the lack of trained employees could be considered as a setback for a company to transition towards Industry 4.0. 27 (54%) participants considered high costs to be an issue for the company's transition, while 21 (42%) believed that a problem would be the little understanding of

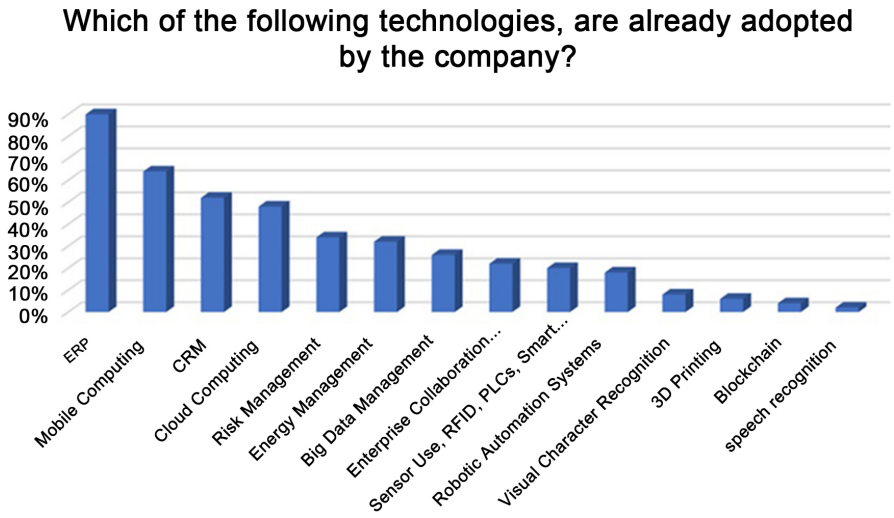
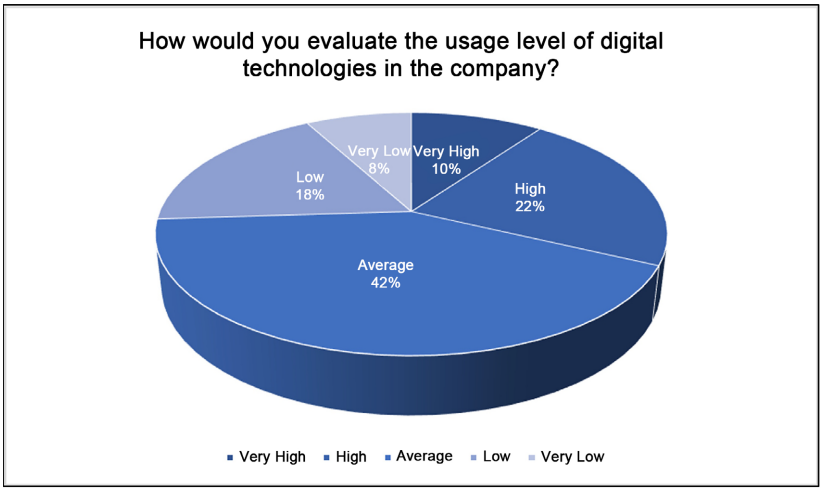


Figure 4. Technologies adopted by the company. (created by the authors).



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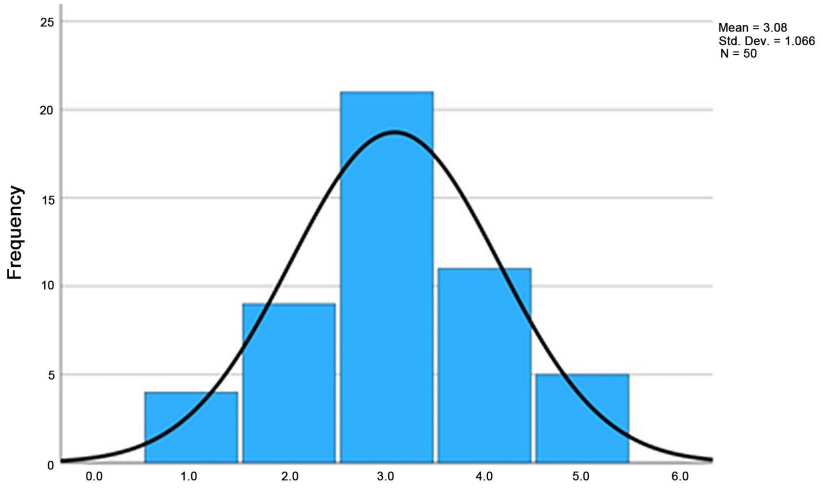

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Figure 5. Usage level of digital technologies in the company. (created by the authors).

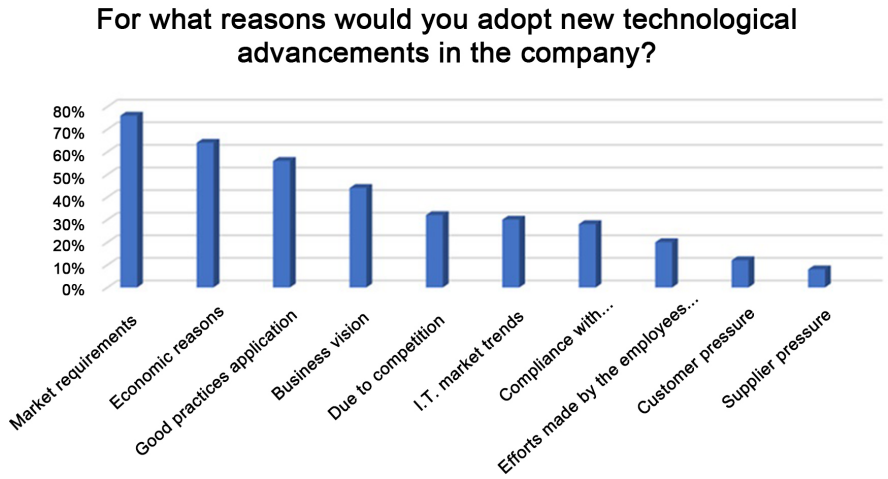


Figure 6. Reasons for adopting new technological advancements (cloud computing, blockchain, multiple data source analysis etc.) in the company (created by the authors).

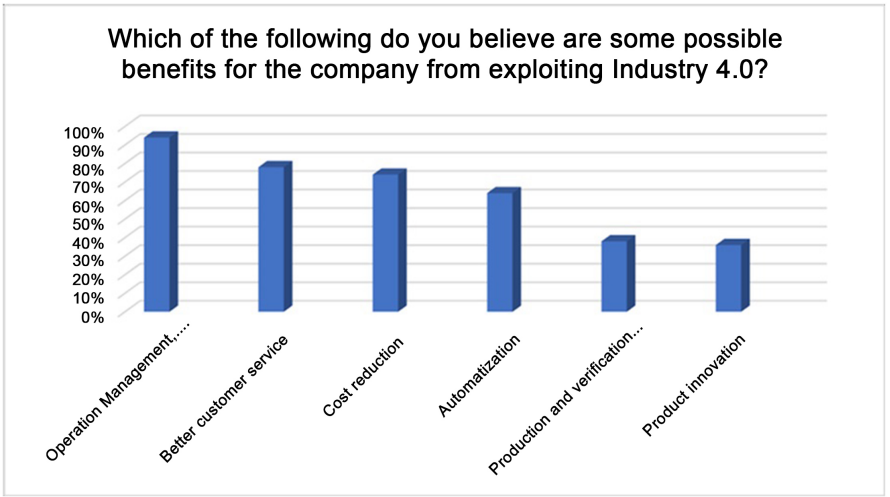


Figure 7. Possible benefits for the company from exploiting Industry 4.0 (created by the authors).

the importance of Industry 4.0. Moreover, 19 (38%) participants claimed that additional time investments could be a difficulty for the company, the lack of methodological support regarding the application of Industry 4.0 was the answer of 15 (30%) participants, while 11 (22%) participants responded that the lack of equipment or software could be a problem. Finally, the lack of trust in the safety of certain areas of Industry 4.0. was stated as an issue by 10 (20%) respondents and the lack of regulations/legislation was considered as a setback by 3 (6%) participants (**Figure 8**).

Concerning the usage of digital systems, 40 (80%) organizations stated that they used these systems in their economical/financial practices, 34 (68%) organizations used digital systems in sales and customer management processes, while 26 (52%) of the responding companies made use of digital technologies in their supplies processes. Furthermore, 24 (48%) companies used digital systems in

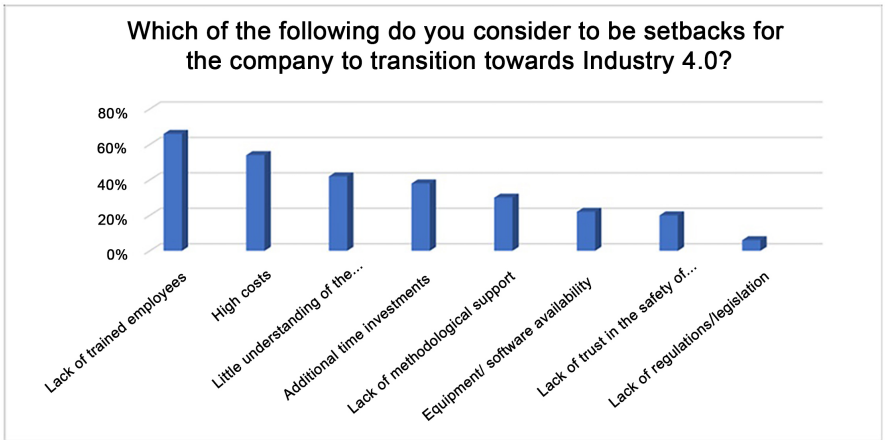


Figure 8. Company's setbacks to transition towards Industry 4.0. (created by the authors).

quality and check assurance practices, 17 (34%) organizations adopted digital technologies in production planning, whereas 16 (32%) companies used these technologies in after-sale services (**Figure 9**).

25 (50%) companies stated that they were already carrying out automated applications/software, 4 (8%) believed that the company would be in a good place to make use of automated applications in the next 12 months, 9 (18%) organizations would be able to make use of these technologies in 1 to 3 years, while 11 (22%) believed that they could adopt automated application in 3 to 5 years. Finally, only 1 (2%) company stated that they would be in a good place to make use of these applications or software in more than 5 years (**Figure 10**).

10 (20%) companies believed that they would take advantage of the opportunities that come with Industry 4.0. by internal factors, while 12 (24%) companies stated that the adjustments would take place once the market demands it. The rest of the companies (28% - 56%) answered that both internal and external factors play a significant role (**Figure 11**).

In the question about the challenges concerning transition towards Industry 4.0, the participants were asked about the time required for training, specialization required in I.T., fear of something new and the feeling of staying behind when it comes to technology. Regarding time, most of the respondents 28 (25%) believed that it would be very challenging, 2 (4%) participants stated that it would be a lot challenging to find time for training, while 10 (56%) participants said that the challenge is at an average level. Moreover, 7 (14%) participants claimed that the time required for training has a low level of challenge and 3 (6%) answered that they did not find any challenge in this (**Figure 12**).

Regarding the specialization required in I.T., most of the respondents (20 – 40%) stated that this is a challenge of an average level. 4 (8%) participants believed that this is a lot of challenging, 14 (28%) of respondents said that it is very challenging, while 10 (20%) stated that had a low level of challenge. Only 2 (4%) respondents claimed that the specialization in I.T. had no challenge at all (**Figure 13**).

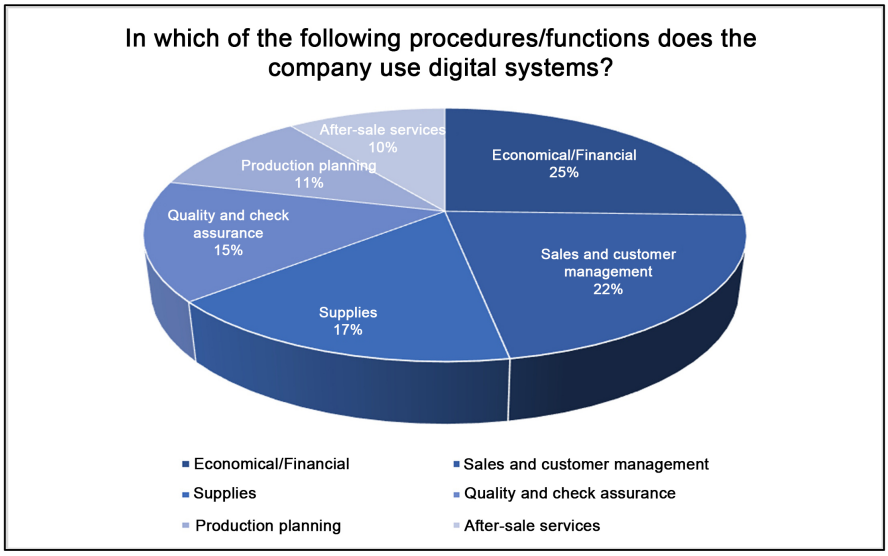


Figure 9. Procedures/functions that use digital systems (created by the authors).

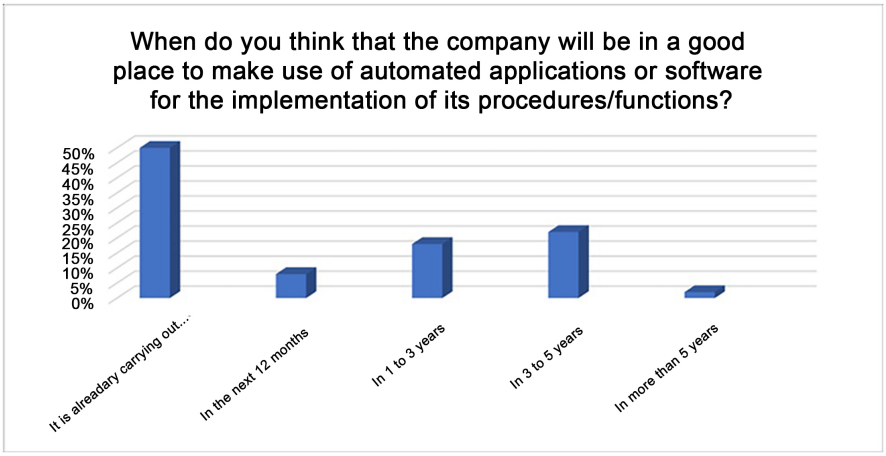


Figure 10. Time horizon for the adoption of automated applications or software (created by the authors).

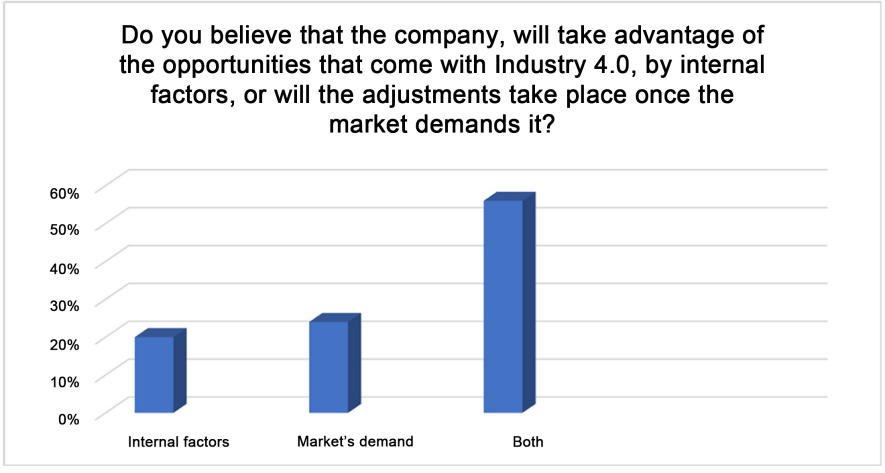
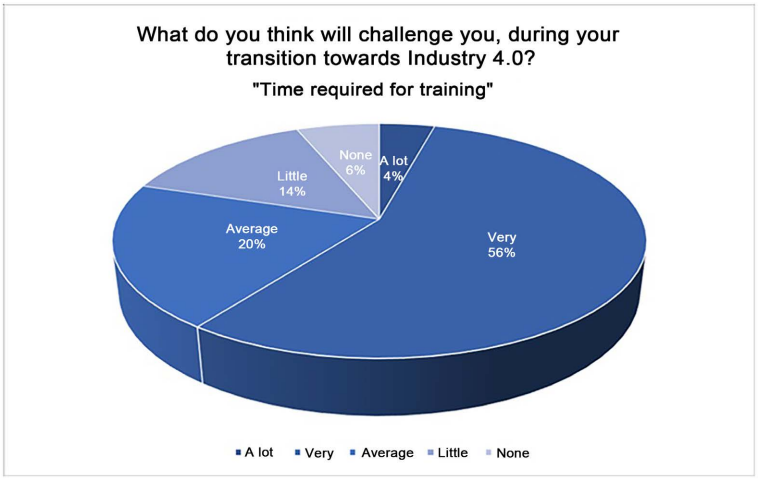


Figure 11. Internal vs. External factors (created by the authors).



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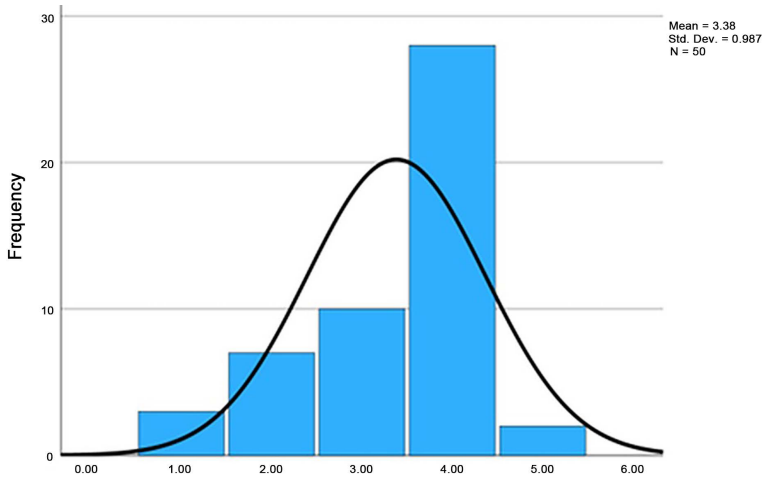

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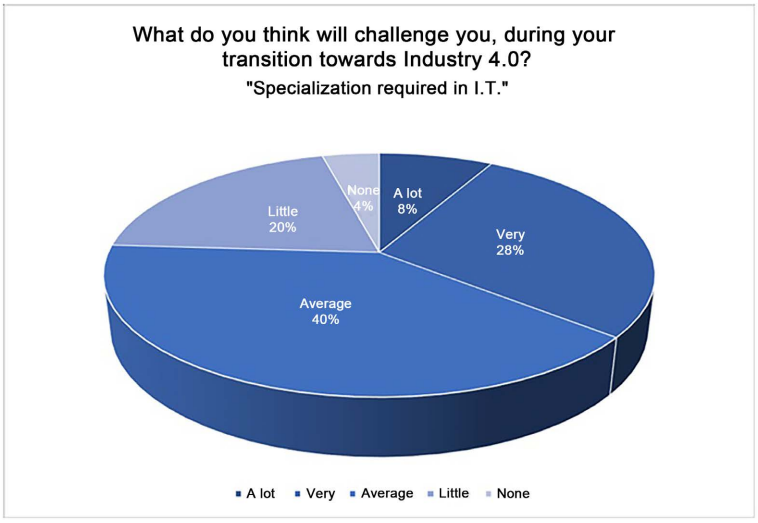
Figure 12. Challenges regarding transition towards Industry 4.0 (created by the authors).



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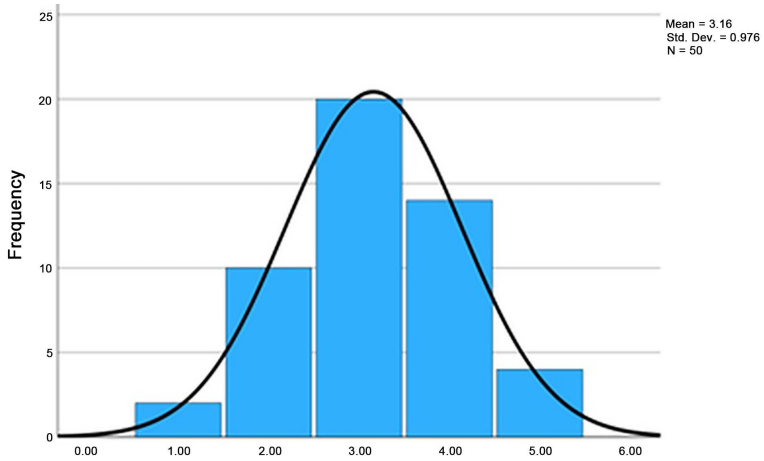

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Figure 13. Specialization required in I.T. (created by the authors).

Moreover, only 1 (2%) respondent feared a lot the "new". 4 (8%) participants stated that the fear of something new had a high level of challenge, while 11 (22%) respondents thought that this has an average level of challenge. 12 (24%) respondents believed that the fear of something new had a low level of challenge, whereas most of the respondents (22% - 44%) said that they did not find any challenge in this (**Figure 14**).

The variable "What do you think will challenge you, during your transition towards Industry 4.0?" consists of 4 items and the reliability coefficient is 0.743 > 0.7, which means that the 4 questions are coherent.

Finally, regarding the feeling of staying behind when it comes to technology, 3 (6%) respondents found it a lot of challenging, while 3 (6%) believed that this was very challenging. Also, 13 (26%) participants stated that this feeling has an average level of challenge, 14 (28%) respondents said that this had a low level of challenge, while 17 (34%) participants claimed that the notion of staying behind was not a challenge for their company (**Figure 15**).

Having what it takes to succeed inside the environment of the intense changes that Industry 4.0 brings 8 (16%) stated that they believed a lot in having what it takes to succeed inside the environment of the intense changes that Industry 4.0 brings. Most of the respondents (29% - 58%) answered that they had a high degree of what it takes to succeed, while 10 (20%) participants stated that they had what it takes at an average level. Finally, 2 (4%) respondents claimed that they had low levels of what it takes, whereas only 1 (2%) participant believed that he/she did not have anything at all (**Figure 16**).

4 (8%) respondents stated that they believed a lot that companies were sufficiently prepared to train their staff for the new digital skills that Industry 4.0. requires. 6 (12%) respondents believed at a high degree the above statement, while 16 (32%) participants answered neither high nor low at the same statement and 18 (36%) respondents stated that companies were prepared at a low level to

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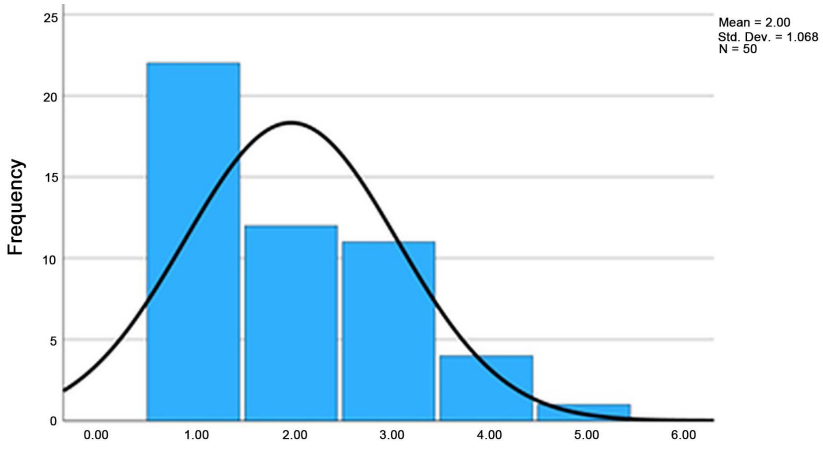

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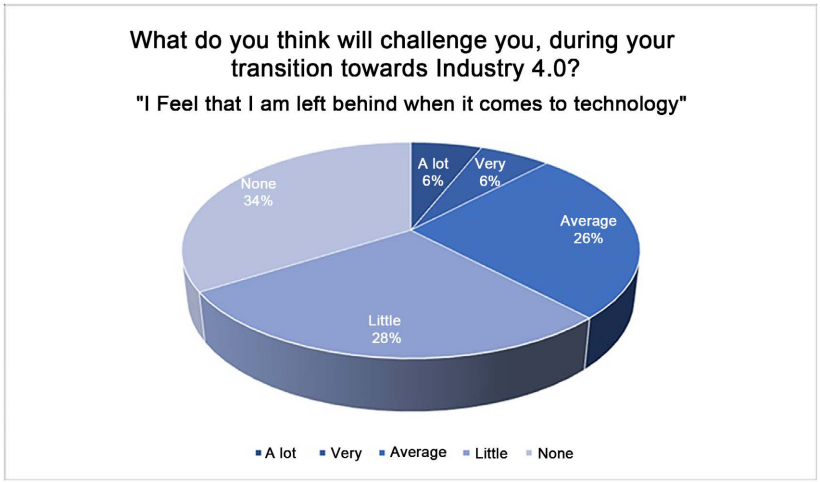
Figure 14. Challenges regarding transition towards Industry 4.0 (Fear of something new). (created by the authors).



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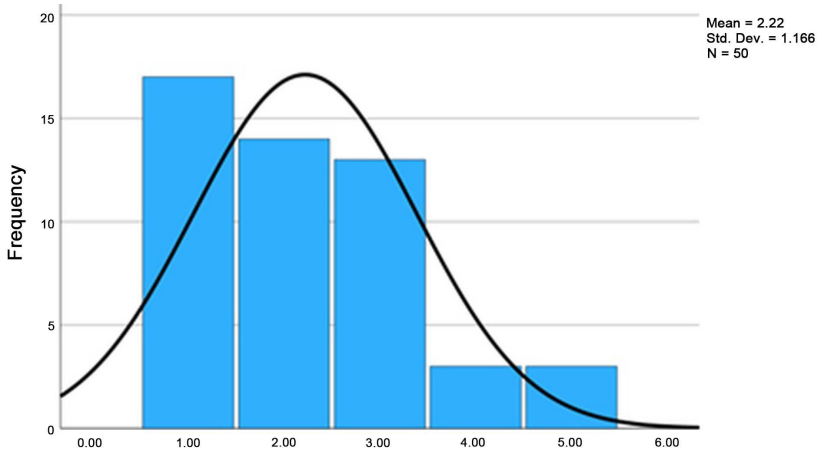

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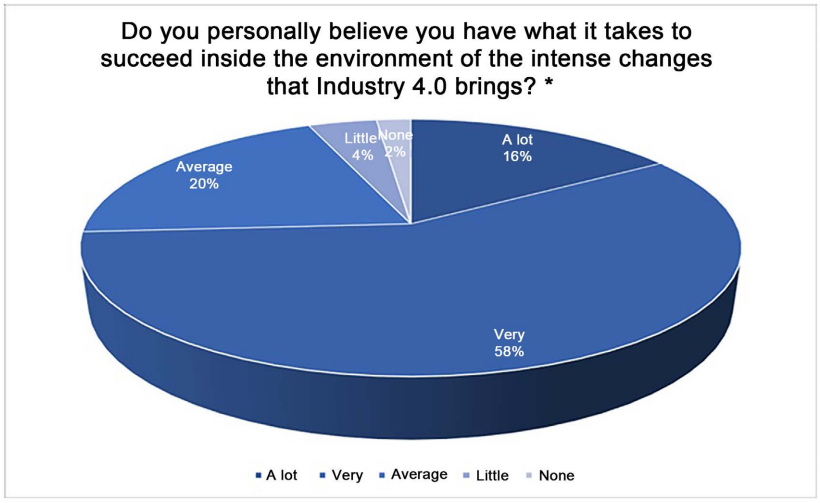
Figure 15. Challenges regarding transition towards Industry 4.0 (left behind) (created by the authors).



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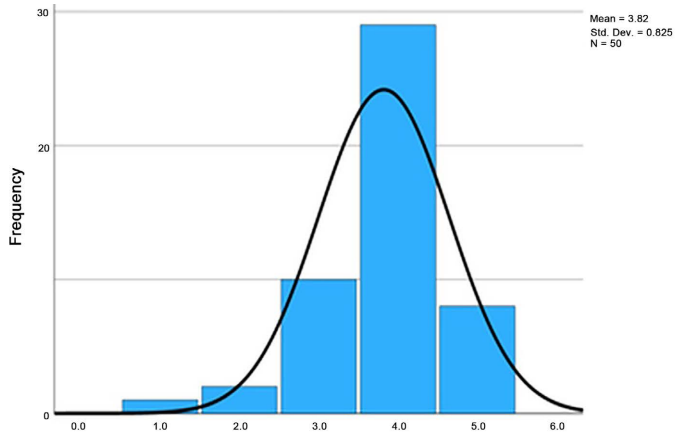


(b)

Figure 16. Having what it takes to succeed inside the environment of the intense changes that Industry 4.0 brings (created by the authors).

train their employees, whereas 6 (12%) participants believed that companies were not sufficiently prepared to train their staff for the new digital skills (Figure 17).

15 (30%) respondents stated that Industry 4.0 contributes a lot to green production. Moreover, 20 (40%) participants answered that the new technologies have a high contribution to green production, 8 (16%) participants believed that these technologies have an average contribution, while 6 (12%) stated that Industry 4.0 has a low contribution. Finally, only 1 (2%) respondent answered that digital technologies have no contribution to green production (Figure 18).

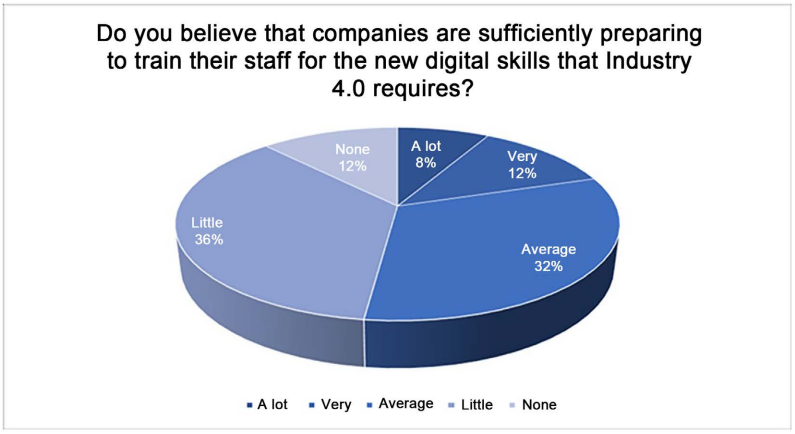
In this question, one of the participants did not respond; thus, the total number of answers is 49. Based on the above, 39 (79.6%) companies had an ISO 9001, 25 (51%) companies had an ISO 14001, while 14 (28.6%) had an OHSAS 18001. Moreover, 13 (26.5%) participants stated that their organization had an ISO 27001, 12 (24.5%) said that they had an ISO 22000, 7 (14.3%) companies had an ISO 50001, while 2 (4.1%) organizations had an EMAS and a BRC. Finally, 1 (2%) company stated that had an IMS, an IFS, a DIN EN14224, and an ISO 13485 (Figure 19).

In the past two years, 36 (72%) companies have invested in digital technologies, while the rest 14 (28%) have not (Figure 20).

In the last question, 30 (60%) respondents stated that the ability to attune new technologies in the already existing systems affects the company's decisions for investments. 25 (50%) participants claimed that the level of understanding of the role of the digital systems in the company influences the decisions regarding investments in digital technologies, while 23 (46%) of the respondents believed that a properly skilled staff could affect these decisions. Finally, customer satisfaction was stated by 19 (38%) participants as a reason that affects the company's decision for investments in digital technologies, whereas 14 (18%) respondents answered that new technology is fundamental for their business model (Figure 21).

4. Conclusion and Recommendations

Through a questionnaire survey the study identifies some interesting insights from Greek companies, across the business spectrum, towards IR4.0 approach. According to the survey a significant percentage of entities understand the term of IR4.0, and believe that the challenges to change, due to IR 4.0, will not be significant for them. In addition, the analysis of the responses showed that the ERP system is the main adopted form of technology towards digital transformation. Sensors, IoT, Blockchain, Cyber-Physical Systems or machine to machine technologies are unknown or without application. Amongst the respondents, the manufacturing companies have the appropriate level of readiness for taking advantage of the changes under IR 4.0. It is also remarkable that there are still some businesses, including some manufacturing companies that have not even included digital transformation in their plans.



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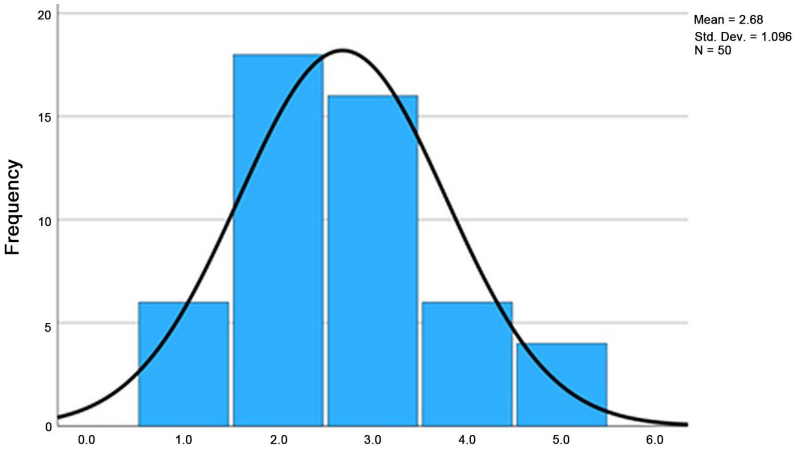

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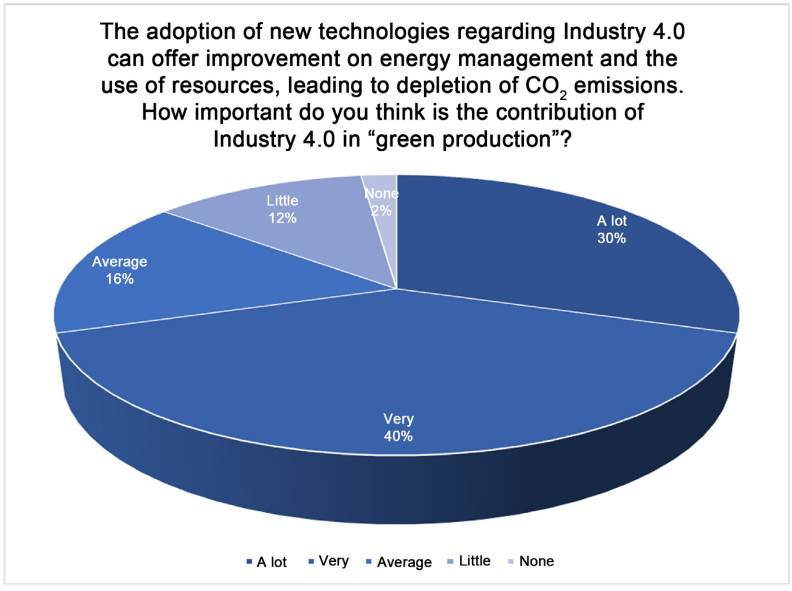
Figure 17. Staff training for the new digital skills that Industry 4.0 requires (created by the authors).



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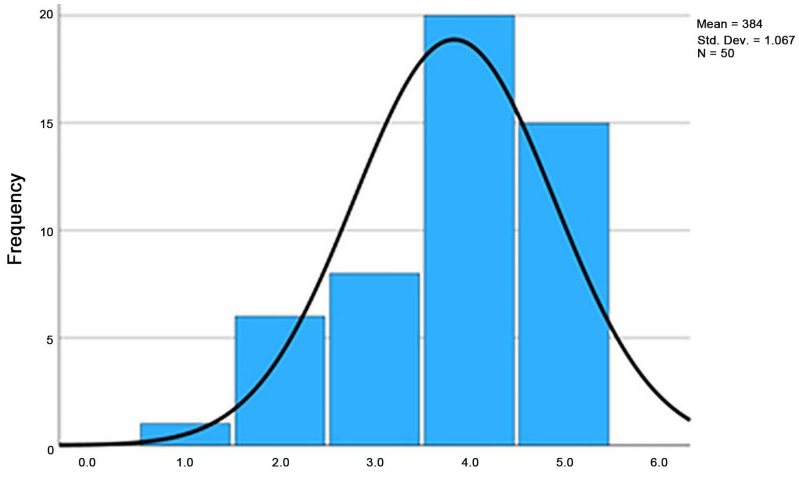

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Figure 18. Contribution of Industry 4.0 in "green production" (created by the authors).

Figure 19. Company's certificates. (created by the authors).

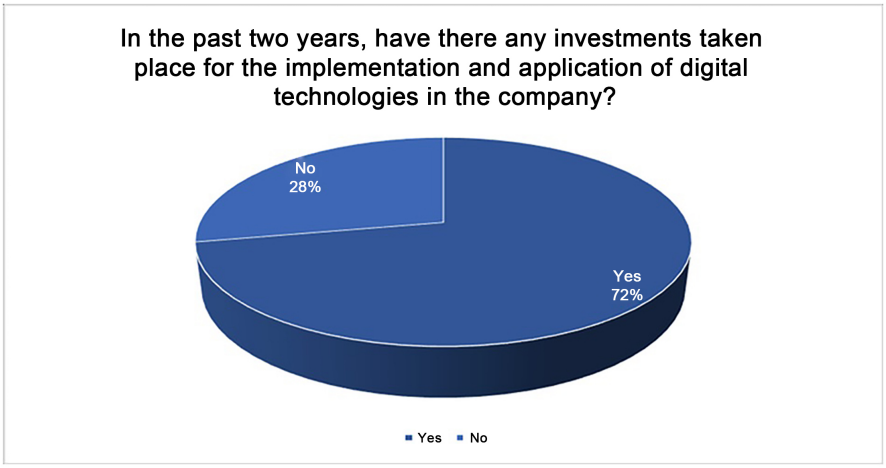

Figure 20. Investments taken place for the implementation and application of digital technologies in the company (created by the authors).

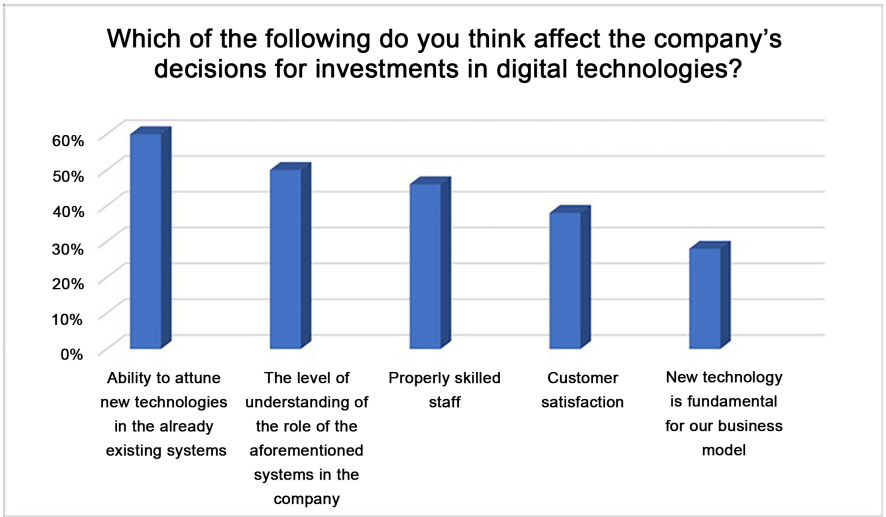

Figure 21. Reasons that affect the company's decisions for investments in digital technologies (created by the authors).

Regarding the Business strategy, there is a lack of strategic direction towards Industry 4.0, but it seems that there are points of easy adaptation to environmental, social, and governance (ESG) factors since most companies have adopted basic management systems such as ISO9001, ISO14001, OHSAS 18001/ISO45001 which are a good basis for ESG development.

In terms of production, no smart manufacturing technologies, agile or Lean methodologies or systems based on production flexibility have been adopted. Perhaps the next and easiest step would be to connect the existing machines and systems with sensors so as to collect a large amount of data which can be used for better planning and management of the production process.

Businesses are not yet convinced of the advantages of industry 4.0, perhaps due to the unclear benefits and the high cost of adopting various new technologies. The implementation of ERP systems though is a very optimistic fact.

Last but not least, a future survey with the same companies would be really helpful to be conducted again in order to identify whether the pandemic forced companies to adopt new technologies, and the extent as to which these technologies had an impact on their overall performance.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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