INDUSTRY 4.0 IN PRACTICE – EXPLORING THE CHALLENGES OF ADOPTION IN THE IT SECTOR

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Abstract

Understanding that Industry 4.0 has the potential to accelerate the economic growth, competition, and sustainability, this paper aims to investigate the implementation of these technologies, along with their benefits, costs, and main challenges, within the Information Technology industry sector. A quantitative survey was conducted by using a structured questionnaire designed on a specific set of criteria among reputable IT companies in North Macedonia. Based on the research, a conceptual model was developed for the adoption of new technologies. The research findings indicate that the integration of new technologies with currently used technology represents a crucial challenge, while the lack of a skilled workforce remains a vulnerable issue for the pursuit of new technologies. Moreover, the main benefits of applying the Industry 4.0 concept in the business processes of IT industry organizations are automation and increased productivity.

The present study is a contribution to building a knowledge base on what is currently happening in the field of Information Technology with respect to incorporating Industry 4.0 technology into its business models. As the field of Industry 4.0 continues to alter business operations, marking a new era in which digital technologies effortlessly integrate with traditional practices, its influence remains a determinant to success.

Keywords: Industry 4.0; Technology; Utilization; Implementation; Transformation; IT Companies.

1. INTRODUCTION

Industry 4.0, or the fourth industrial revolution, presents unparalleled opportunities for a prosperous future, now and in times to come, by rewiring how a business operates. These changes were a series of techno-advances coupled with the Internet of Things (IoT), Artificial Intelligence (AI), Cybersecurity, Machine

Learning, and Cloud Computing, letting businesses herald a change in operational effectiveness, optimize, innovate, or upgrade their business models. Such digital transformation calls for strategic planning and overt information about challenges and obstacles (Fonseca, 2018). Businesses, therefore, linked to devices and analytics of actual facts in time, optimize their supply chains, screen manufacturing in real time, and predict marketplace tendencies with far greater accuracy (Chowdhury, 2024).

Furthermore, Industry 4.0 enables companies to get right of entry to new business models and markets that were formerly out of reach, ensuring greater personalized and progressive offerings. Throughout the use of digital structures, even the smallest companies can scale their operations and attain an international audience.

Through the advancement of transformations, companies will have the ability to work with larger companies, thus creating new opportunities for innovation (Carvalho et al., 2019). Essentially, companies that have embraced the Industry 4.0 technologies will have the chance to overcome the current challenges that the ever-changing digital environment has to offer, thus gaining success in the digital age.

This shift towards Industry 4.0 offers the potential to streamline production procedures, reduce prices, and deliver more personalized services and products to meet converting purchaser needs (Brocal et al., 2019). It is worth highlighting the research conducted in Poland by authors Wyrwicka & Mrugalska (2017). Indeed, the Industry 4.0 implementation in this country takes a pace much faster compared to mature markets, with an increase of about 20%. Considering the previous discussion, one can concluded that the ability of Macedonian organizations to adapt to new technologies is crucial for their sustainability. However, the adaptation process is not quite simple. Consequently, investigating driving technologies, their level of integration with existing systems, as well as the challenges that IT companies encounter during the implementation and ongoing utilization, emerges as a major research incentive. Specifically, the considered research problem focuses on the following goal: *to explore the specific challenges and obstacles to the adoption of Industry 4.0 technologies in the Macedonian IT industry.*

In fulfilling the research objectives, the proposed process for conducting this research paper combines qualitative and quantitative research methods. Specifically, a literature study is employed for qualitative research, while a survey is used for quantitative research. In terms of methodology applied in conducting this research paper, it involves five phases: (1) a thorough process of conducting a literature study research, (2) a process of designing a research questionnaire, (3) a research survey conducting process, (4) a process of interpreting research results, and (5) a process of development of a conceptual model based on the systematization of the gathered findings.

2. LITERATURE REVIEW

The initial methodological step of this research involves a comprehensive review of relevant literature sources. The literature review was conducted from 1st October 2024 to 15th February 2025. A total of 42 papers in the area of Industry 4.0 technologies implementation and ongoing utilization in business operations have been found, according to the keywords: Industry 4.0, Implementation, Technology, Digital transformation, and IT companies.

With the advancement of Industry 4.0, organizations are presented with emerging opportunities for innovation and the enhancement of business practices (Gajić, 2024; Sarkar et al., 2020; Sader, 2019). In the view of Shaba et al. (2019), since organizations are often referred to as the coronary heart of the local economy and job creators, the blend of these emerging technologies will be the crucial determinant in the shaping of the destiny of these organizations (Kiss et al., 2019; Sartal et al., 2020; Gündoğan & Babayigit, 2017).

2.1. The impact of AI on business operations

Considering Rocha & Kissimoto's (2022) views, AI and ML are already recognized as key elements of many Industry 4.0 technologies, yet their full potential is still not comprehended. Ali et al. (2017) argued that AI enhances different dimensions, ranging from customer support through chatbots and virtual assistants to operational activities such as quality management, inventory, and forecaster analysis. Additionally, Rane et al. (2024) suggested that firms could also leverage analytics capability through AI for improved decision-making, optimizing pricing structures and allocation. Similar views are presented by numerous researchers. According to Waqar and others in 2024, automation by AI technology has now been revealed as a revolutionary element in contemporary industries. This results in unprecedented efficiency in the working of companies. As it is seen that the technology is advancing, it can easily be implemented in ongoing operations and activities. As a result, companies would operate and remain able to compete in the international market (Reim et al., 2020). When companies implement technological changes, they automatically see modifications in their business, regardless of the level of adaptation (Gajić et al., 2022). According to Khanzode & Sarode (2020), the main advantages of AI are completing tasks faster than a human, reducing stress and complex work easily, and performing difficult work in a short period. The same authors highlighted the main disadvantages of AI, like human jobs being affected, the unemployment problem increasing, creativity being dependent upon programmers, requiring a lot of time and money, technological dependency increasing, etc.

2.2. The impact of ML on business operations

ML operates by learning from past data to predict what is expected in the future and to recognize failures in a system, as described by Chowdhury (2024). ML algorithms, for example, can scan vast data to recognize various patterns, predict future trends, and facilitate complex processes that were originally challenging, as revealed by Brocal et al. (2019). ML affects operational efficiency in IT companies and allows automation of routine tasks, predictive analytics for performance optimization, cost reduction, and improvement of security and threat detection, state Khanzode & Sarode (2020). By pinpointing inefficiencies in resource utilization, ML empowers IT companies to reduce costs associated with over-provisioning, underutilization of hardware, or unnecessary processes (Ali et al., 2023). Rene et al. (2024) demonstrated that cloud services could leverage ML algorithms to optimize computing resources, storage, and data transmission by examining historical data to anticipate when and where resources will be most required. Furthermore, IT companies use ML together with AI to create smarter and more innovative applications, interactive programs, and positioning of online systems, all in order to increase the price of the product itself and customer satisfaction (Sarkar et al., 2020; Chowdhury, 2024).

2.3. The impact of IoT on business operations

As a core technology within Industry 4.0, IoT represents a network of physical appliances with sensors and software that allow them to communicate with each other to share data (Botta et al. 2016). Rocha & Kissimoto (2022) proved that IoT is a revolutionary technology which has-transformed the manner by which industries function to date by connecting everyday objects to the internet to facilitate data collection and sharing (De Souza, 2025). Together with AI, this technology has benefited process optimization by providing real-time decision-making tools, predictive maintenance procedures, automated processes, and a better customer experience (Tohanean, 2018). Waqar et al. (2024) emphasized different motivations behind the use of this new phenomenon called IoT, which includes competitiveness, massive amounts of data produced by different devices connected to this phenomenon, lack of resources, or differing speeds of decision-making. The potential of these technologies to transform business models, enhance efficiency, and foster innovation is more than meaningful (Gajić et al., 2024) are. Cloud Computing services have given a tremendous boost to the creation of efficient and effective solutions (Beta et al., 2016; Rahul et al., 2012). According to Arwen (2017), the growth of these technologies has greatly transformed IT companies, primarily in their flexibility, costs, and collaboration, so it can be confirmed that these technologies are a vital resource today.

2.4. The impact of Cloud Computing on business operations

Golightly (2022) regards Cloud Computing as a fuel that drives product development, customer experiences, data processing, and businesses. Going forward, with the integration of new technologies such as AI, ML, and Edge Computing into the structure of Cloud Computing, there shall be bigger possibilities for IT companies to stimulate innovation in their businesses and smoothen their processes (Avram 2014; Khatib et al., 2019). This has been asserted by researchers such as Naik et al. (2012), Mittal et al. (2017), Tharmin et al., (2012), and D'cruze (2010). Actually, the integration of Cloud Computing in the technology sector and globally in all spheres, transforms IT companies in the ways they manage infrastructure, offer services, and effectively fulfill their obligations to customers. Additionally, integration between Cloud Computing and the IoT enables efficient data collection and analysis remotely, facilitates effective cross-divisional collaboration, and enables the development of complex projects (Yuniarto, 2023; Attaran, 2017). Furthermore, cloud providers make substantial investments in security measures, including encryption, multi-factor authentication, and continuous monitoring to safeguard data against breaches (Pawreen & Pawreen, 2017; D'cruze & Kokkinos, 2010). However, the Cloud Computing flexibility and ability to provide resources on demand enable businesses to quickly respond to market demands and improve service delivery (Muntjir et al., 2012).

2.5. The impact of Cybersecurity on business operations

Yet, all this has also brought too many challenges in the field of Cybersecurity, primarily in protecting personal and important data that companies have (Hasani et al., 2023; Sartal, 2020; Ervural & Ervural, 2017). On the other hand, the characterization of the Cybersecurity concept within Industry 4.0 contexts proved to be an emerging and relevant topic in the recent literature (Lezoche & Panetto, 2020; Lezzi et al., 2018; Hasan et al., 2021; Hasani et al., 2023). Kiss and collaborators (2019) stressed that Cybersecurity is not solely the responsibility of IT departments; actually, it is a collective effort that must be ingrained in the organizational culture. Numerous researchers argue that by proactively identifying and mitigating security risks, IT companies can timely and securely preserve critical data they own, maintain business and customer service at a high level, and increase public trust (Malaivongs et al., 2022; Abrahams et al., 2024; Berlilana et al., 2021; Ewuga et al., 2024). The result is an adoption of an exceptionally effective Cybersecurity system that diminishes every risk associated with businesses, including losing consumers and incurring financial losses (Lezzi et al., 2018; Saleem, 2017; Ali et al., 2025; De Arroyabe & De Arroyabe, 2021).

Although the literature review emphasizes the increasing need for Industry 4.0 implementation to boost competitiveness and support sustainable development, the process of adopting these technologies in Macedonian IT companies, remains insufficiently explored.

3. RESEARCH FRAMEWORK

The aims of this research are to assess the most frequently adopted emerging technologies in Macedonian IT sector and identify the degree to which they are integrated into organizations. The research also classifies the barriers and identifies the major challenges related to their implementation. Additionally, the research aims to evaluate the benefits companies acquire from using new technologies and estimate the organizational funds based on integrating digital technologies into the operation of a business.

Questionnaire design

The methodological framework includes the design of a structured questionnaire. Thus, the questionnaire is composed of seven questions (determined specific criteria), offering multiple categories of optional answers in accordance with the research objectives and allowing the selection of more than one answer. In addition, the introductory part of the questionnaire consists of general questions related to the name and size of the company and the job position of the respondent.

Data collection

The questionnaire was designed to collect data from reputable IT companies in North Macedonia on the seven mentioned criteria. A total of 40 IT organizations participated in the survey. Through the developed structured questionnaire, data were collected from 27 companies, starting from February 1, 2025, to March 1, 2025. The response rate was 63%. The participation of the surveyed organizations according to the number of employees' criterion: 22% were small organizations (less than 50 employees), 41% medium-sized organizations (between 50 and 251 employees), and 22% for large organizations with up to 251 employees. About the occupational roles of the respondents, 36% were software developers, followed by managers with 24%, 12% software engineers, 12% businessmen, 4% for software testers, 4% web developers, and finally, 4% team leaders. Actually, this survey contains a wider scope of job positions of the respondents.

4. RESULTS AND DISCUSSIONS

In terms of the technologies utilized by the surveyed companies, as presented in Table 1.

TABLE 1 – IDENTIFICATION OF THE ADOPTED TECHNOLOGIES IN THE IT COMPANIES

Type of technology	Collected responses (%)
Artificial Intelligence	48
Machine Learning	37
Big Data	30
Claud Computing	59
Internet of Things	18
Cyber security	52
Other technologies	18

Actually, 59% of the respondents were able to verify that the most used technology is the one provided by Cloud Computing, and 52% believed that Cybersecurity is given high importance in business processes. AI is the third most popular technology (48%) in the list, which is an indicator of the great interest in intelligent solutions for automation and optimization processes. Additionally, the use of ML is being practiced by 37% of the companies in the sector; this is an indicator that the majority of the companies in the industry are using the AI ecosystem in general for the analysis of data and construction of intelligent models. Other options in the list include the 30% of the respondents that addressed the topic of Big Data and the 18% that chose the topic of IoT. It is apparent that even though the technologies of Big Data can be very useful in the processes of big data analysis, they are currently underutilized. A similar conclusion applies to IoT practice, with the notable observation that IoT is more commonly implemented in smaller organizations. In addition, 18% of respondents indicated *JavaScript, Full Stack Development,* and *DevOps* (classified under *"Other technologies")* as practiced technologies. In conclusion, most of the companies are focused on technologies, demonstrating growing interest in intelligent and advanced digital systems, and accepting secure technological solutions.

The next question concerns the integration of selected technologies within the surveyed companies. The pie chart given in Figure 1 is generated by the two selected respondents' answers, i.e., *"fully integrated technologies"* and *"partially integrated technologies"* out of five offered answers.
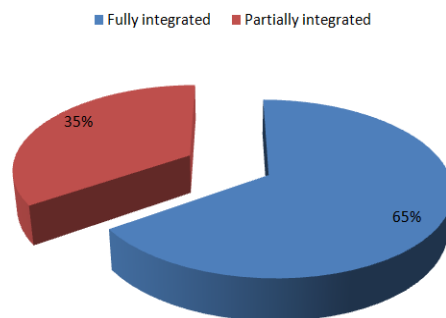

FIGURE 1 – DEGREE OF EMERGING TECHNOLOGY INTEGRATION AMONG IT COMPANIES

According to the collected data, 65% of the companies confirmed the full integration of digital technologies, while 35% of them specified the partial integration of particular technology. The other offered options include *"integration is in pilot phase", "the integration is in planning phase"*, and *"not integrated at all".* The high percentage of full and partial integration of digital technologies indicates the high level of awareness of all participants in the conducted survey regarding the significant importance of implementing and utilizing advanced technological solutions. The obtained results clearly indicate that there is a high level of digital maturity in Macedonian IT companies.

The assessment of challenges during the process of implementation of emerging technologies is presented in Table 2.

TABLE 2 – ASSESMENT OF CHALLENGES BEFORE STARTING THE EMERGING TECHOLOGIES IMPLEMENTATION

Type of analyzed challenge	Collected responses (%)
Integration with existing system	63
Replacement of current processes	56
Lack of skills and knowledge	37
Data privacy and security	33
Lack of productivity	18

The *"integration with existing system"* is identified as the most significant challenge (63% of respondents). However, the process of implementation cannot be considered as a simple technical activity, but rather as a long-term adoption and synchronization with existing operational processes. In addition, this transformation influences the overall structure, routines, and roles in the companies. The second-rated statement relates the *"replacement of the current processes"* with new technologies (56%). In essence, the respondents believe that the radical changes in current operational performance lead to personnel resistance to changes, distrust, and fear of new technology's utilization. Furthermore, the next rated challenge (37%) refers to *"lack of knowledge and skills of employees".* Obviously, there are close relations with the previous survey, due to the key barrier recognized as the lack of training and insufficiently skilled personnel. It is more than clear that without investing in workforce abilities improvement, the emerging technologies are not enough to produce expected results on their own. Regarding the 33% respondent attitudes, *"data privacy and security"* is the challenge ranked in the next (fourth) position. It is notable, that the both, a technical and legal challenge in the IT sector, still not regulated on the satisfactory level. Yet, the IT companies themselves are sufficiently aware about the importance and commitment to the protection of data and privacy. The remaining assessment refers to the *"lack of productivity".* Specifically, 18% of respondents select this option as a main challenge, due to their expectation of increasing productivity throughout the successful implementation of digital technologies.

Generally speaking, it can be concluded that for the successful implementation of new technologies, a holistic approach is required, including the perspectives of human resources, connectivity with the existing technology, and organizational ability toward new technologies.

The processed data concerning the identified barriers during the implementation of new technologies within companies are clearly presented in Table 3.

TABLE 3 – IDENTIFIED BARRIERS DURING THE EMERGING TECHNOLOGIES IMPLEMENTATION

Type of analyzed barriers	Collected responses (%)
Lack of financial resources	22
Lack of innovative ideas	26
Lack of trained employees	39
Lack of institutional support	5
Lack of security	4
Lack of readiness for technological change	4

Specifically, the most frequent barriers are related to the workforce, specifically the *"lack of trained employees".* Technically, 39% of respondents believed that the insufficient training of the workforce represents the most significant barrier to the successful adoption and effective utilization of new technologies. The obtained results address the need to prioritize the development of structured training programs in the direction of enhancing the digital competencies of the IT workforce in domestic IT companies. The next most common barrier refers to the managerial strategic vision and the company's capacity for innovation and creativity. In particular, 26% of respondents highlighted the *"lack of innovative ideas"* as a major barrier. Another relevant barrier, stated in 22% of responses, was related to a *"lack of financial resources".* The optional answer *"lack of readiness for technological change"* within the IT companies was confirmed as a barrier by 4% of respondents, while the *"lack of security"*, as the next optional answer, was also marked by 4% of respondents. The 5% of respondents recognize the *"lack of institutional support".* In essence, building a strong strategic vision of integration of cutting-edge technologies, strongly supported by institutions, enables the long-term success of the domestic IT business community. It can be concluded that strategic action is necessary to improve the personnel skills, promote innovative approaches, and find financing possibilities, especially in using the available institutional funds. The results regarding the main benefits of the utilization of emerging technologies in companies are explicitly presented in Table 4.

TABLE 4 – IDENTIFIED BENEFITS OF EMERGING TECHNOLOGIES UTILIZATION

Type of analyzed benefits	Collected responses (%)
Increased competitiveness	63
Increased customer satisfaction	63
Development of innovative products and services	22
Creating personalized services	18
On time and right decision-making	33
Effective risk management	33
Real time data monitoring and analysis	59
Increased productivity	81
Workflow automation	89

The dataset includes seven optional categories. Among all, *"workflow automation"* is highlighted as the most significant benefit, selected by 89% of respondents. In other words, companies can recognize the value of reducing time and saving resources by automating routine and repetitive tasks performed regularly. A similar view, confirmed by 81% of respondents, refers to the *"increased productivity".* According to the respondents' opinion, the free-error tasks execution and effective resource utilization are recognized as a tool that leads to the *"increased competitiveness"* and *"increased customer satisfaction".* Both categories are assessed equally by the 63% of respondents. However, these two categories are related, because above all, satisfied customers often lead to a better positioning and position of the company in the business. The next category, *"real-time data monitoring and analyses"*, was regarded as

highly valuable by 60% of respondents. Particularly, companies recognized the strong impact of data monitoring, tracking, controlling, and data collecting, which improves their ability for *"on-time decision-making"*. Besides this, respondents believed that the data analytics also has a high potential to improve the procedure of reporting, which enables building efficient communication and a smooth flow of information.

A certain number of companies understand the importance of adopting new technologies for successful coping with numerous managerial risks. From this point of view, both optional categories, on time and right decision-making, and *"effective risk management"*, were identified by the 33% of respondents. While only 22% of respondents identified the category *"development of innovative products and services"*, it can be assumed that some of the surveyed companies are still not using the emerging technologies as a tool for innovative potential development. Lastly, only 18% of respondents believed that *"creating personalized services"* is a powerful tool for strategic growth. It seems that fewer Macedonian IT companies keep pace with the global trends, in the sense of attracting customers by tailoring solutions for their needs and building personalized services on a long-term basis. In general, the majority of surveyed companies entirely recognize automation, productivity, and analytics as the key drivers for long-term success. Yet, there is still a gap in terms of future improvement, especially in the field of customization and personalization of delivered outcomes by IT companies.

The collected data regarding the identification of the main difficulties during the utilization of emerging technologies are given in Table 5.

TABLE 5 – PRIMARY OBSTACLES DURING UTILIZATION OF EMERGING TECHNOLOGIES

Type of analyzed obstacle	Collected responses (%)
Compliance with legislation	11
Cybersecurity concerns	31
Data privacy issues	38
High expenses for maintenance	35
Duration of training programs	54
Resistance to technological changes	31
Lack of skilled employees	35
Complex of integration with existing technology	73

The considerable variation observed for the frequency that different types of obstacles are encountered is significant due to the range of 62% (73% − 11%). Thus, complex integration with the existing technology in companies is highly evaluated by the 73% of the respondents. Based on this finding, the need for strong technical expertise can be implied. In fact, the integration of new technologies and synchronization with existing technology should be approached as a complex and sensitive process that deserves careful and detailed planning. Then, the needed time interval for the workforce training issue was identified by 54% of all responses. Most likely, it is expected that during the training programs for new technologies'

utilization, the workforce will be less available for the execution of the regular tasks. From a managerial perspective, the length of training programs is considered a serious obstacle that can affect the company's productivity, decreasing it. Moreover, 38% of the respondents mentioned the issues of privacy protection, whereas 31% pointed to problems with Cybersecurity. Both categories are considered significant barriers that need to be treated appropriately, taking into account the relevant regulatory requirements. In addition to cybersecurity and problems with privacy protection, as well as compliance with legal regulations (11% of responses), these obstacles constitute a pivotal category, especially in the IT industry legislation. This applies to the absence of technically competent staff, which was indicated in the responses of 35%, and resistance in staff to change, which was indicated in the responses of 31%. In essence, the importance of the role of the human factor in the process is reiterated in the present case. One can conclude that the staff's readiness and commitment are an essential precondition for the successful implementation of new technology.

However, in conclusion, it can be said that for the successful utilization of technologies, it should again be noted that continuous education and training, technical care, gradual integration, and ensuring legal standards are required, along with change management in companies.

The overview of the financial investment, referring to the adoption of emerging technologies, is clearly presented in Figure 2.
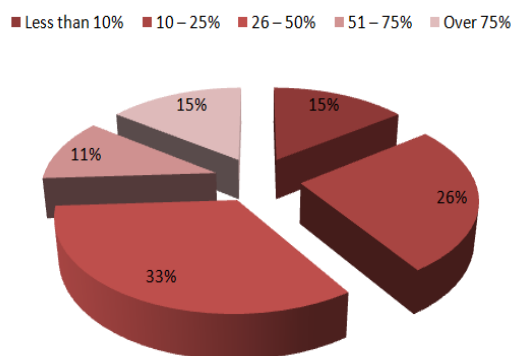

FIGURE 2 – ALLOCATION OF FINANCIL RESOURCES TOWARD EMERGING TECHNOLOGIES INITIATIVES

The most common budget allocation addressed the interval of 26-50% of the budget, confirmed by the 33% of companies. Actually, one-third of the respondents dedicate a significant portion of the company's funds towards investing in new and advanced technologies. As follows, the interval of 10-25% of funds was confirmed by the 26% of companies. This indicates that for some companies, investments in digital technologies are still at an initial or intermediate level. It is noticeable that minimal and extremely high investments are equally represented in the domestic IT sector. Below 10% of budget investments and

above 75% of budget investments have an equal number of surveyed companies (from 15%). These responses go to two extremes, one of which is that some of the companies are in the initial phase of new technologies' adoption, while some of the companies invest intensively in the same direction. The least represented response is the interval of 51-75%, with only 11% of the responses. Seems like a few companies are in an advanced phase of investment and allocation of finances, but have not yet reached their maximum when it comes to digital technologies.

4.1. Critical interpretation of collected results

Based on the collected data and the findings obtained, a substantial set of responses has been compiled to assess the current state of the domestic IT industry. A diverse structure of respondents, which included engineers, developers, owners, managers, etc., in the research is notable. This approach allowed a better understanding of researched issues from both perspectives, technical and strategic. In other words, the treated research includes the perspectives of personnel who are directly involved in the decision-making and also in the process of digital transformation. In terms of the most frequently adopted technologies, it is clear that Cloud Computing is the most prevalent one, with almost 60% of surveyed companies. Cybersecurity and artificial intelligence, as follows, are practiced in certain companies as well. Although Big Data and the Internet of Things are less adopted technologies, they cannot be ignored because they relate to the specific companies' activities. On the other hand, the results for the degree of full technology integration within companies' operations reach a 66%, while the remaining 34% of companies are still in the phase of partial integration. These findings address the high technological maturity and notable readiness for further digital transformation as well. Discussing the major challenges encompasses the implementation process of new technologies, it can be claimed that the biggest one is certainly integration with existing processes, due to the changes encompassed in the daily operations. Highlighted by the majority of respondents, indicates the fact that the implementation of Industry 4.0 is not just a technical process, but rather requires radical changes in the organizational structure in the direction of workforce's mindset and attitude transformation. In the context of resistance to change and distrust of new digital technologies, as one of the confirmed challenges, lies in the lack of training program development and workforce skills enhancement. It is worth to emphasizing the lack of innovation, which is a concern as stated by 25% respondents. However, the availability of technologies cannot be denied, but the fact that the implementation is limited due to insufficient innovative capacity of the companies, remains a vague area that deserves deeper analysis and further research. The remaining barriers, like distrust, an underdeveloped system, and insufficient security, are quite expected in the emerging countries like the Republic of North Macedonia. In this regard, the financial ability and readiness for investments imply a logical consequence of the low scale economies of society. Discussing the benefits of utilizing Industry 4.0 technologies, a dominant aspect is related to process automation and enhanced productivity.

However, a portion of responses indicated that monitoring and analysis are key to making timely and correct decisions, and another portion of responses deals with improved customer satisfaction and market competitiveness. These findings indicate the significance of technology inclusion, but as a corporate strategic goal, not only as a benefit for improvement on the operational level within the IT companies. It is clearly confirmed that AI brings numerous positive effects, where the automation and personalization functionalities can be significantly improved. Furthermore, the importance of data protection and risk management based on Cybersecurity was highlighted, which demonstrates the crucial role of awareness and responsibility throughout digital transformation. On the other hand, the main difficulties in the utilization of new technologies are related to the complexity of integration with existing technologies and, as was previously mentioned, the necessity of workforce training. Moreover, the lack of expertise, resistance to changes by employees, and the initial high costs of integration are also identified as significant obstacles. Furthermore, the privacy protection and low and regulations issues contribute to the gathered dataset. In general, the obstacles can be recognized as a mix of technical, human, and legal support standing points. The last examined criterion in the conducted survey relates to the financial aspect. The findings indicate the meaningful portion of companies' funds necessary for investment in new technologies. Yet, there are still parts of companies that are slowly moving towards digital transformation, coping with a lack of funds. It is interesting that the optional answers, minimum budget (up to 10%) and the highest budget (under 75%), are equally outlined by 15% of respondents. One can conclude that there are younger IT companies that are in the initial stage of integration of advanced technologies, but on the other hand, there are also companies that completely integrate one or a few technologies.

Depends on the conducted research and the clarified data, an attempt to systematize the findings has been made. For that purpose, the most relevant activities have been included in the conceptual model to explicate and understand the meaning of those findings and mutual relations.

It is not disputed, from any point of view, that the implementation of advanced technologies is a lengthy process. Hence, the top management has a crucial role in establishing companies' policies, providing resources, stimulating the involvement of the workforce for successful integration of new technologies, and transitioning towards higher digitalization. Therefore, the discussion in terms of initiatives towards the implementation of new technologies always starts from the top management, but does not depend on their commitment. The employees are the implementers and supporters of all ideas generated by the top management. The top management should actively communicate the company's philosophy to the employees and involve them in the new technologies utilization efforts. Therefore, the influence of the workforce's knowledge and skills in order to utilize new technologies is crucial and symbiotically linked with the top management. In addition, management plays a vital role in providing financing funds for the execution of planned investments in new technologies.

Once management support is provided, the barriers that are expected to arise during the implementation process must be taken into consideration. Actually, it is essential to plan the measures for coping with the numerous challenges encompassed by the new technologies' implementation. In this direction, the compatibility of existing and new technology must be grasped as a priority for smooth running and operational alignment. Once a satisfactory level of integration is achieved, the new technology can be adopted, and the utilization can start regularly. In this regard, the benefits of new technologies' utilization should be deliberated. Exactly, the key performance indicators should be determined to enable the measurement and comparison of the accomplished values in the operational process. Apparently, improved performances increase the optimization and efficiency of operational processes. The gathered benefits of new technology utilization represent a trigger for further investments, strongly supported by the top management. In sum, this systematic approach leads to overall improvement, increases competitive advantage in the market, and achieves long-term success of IT companies. Based on the systematization of the gathered findings in the conducted research, a conceptual model was developed and presented in Figure 3. Additionally, this model represents only a simplification of a real process for the adoption of new technologies.
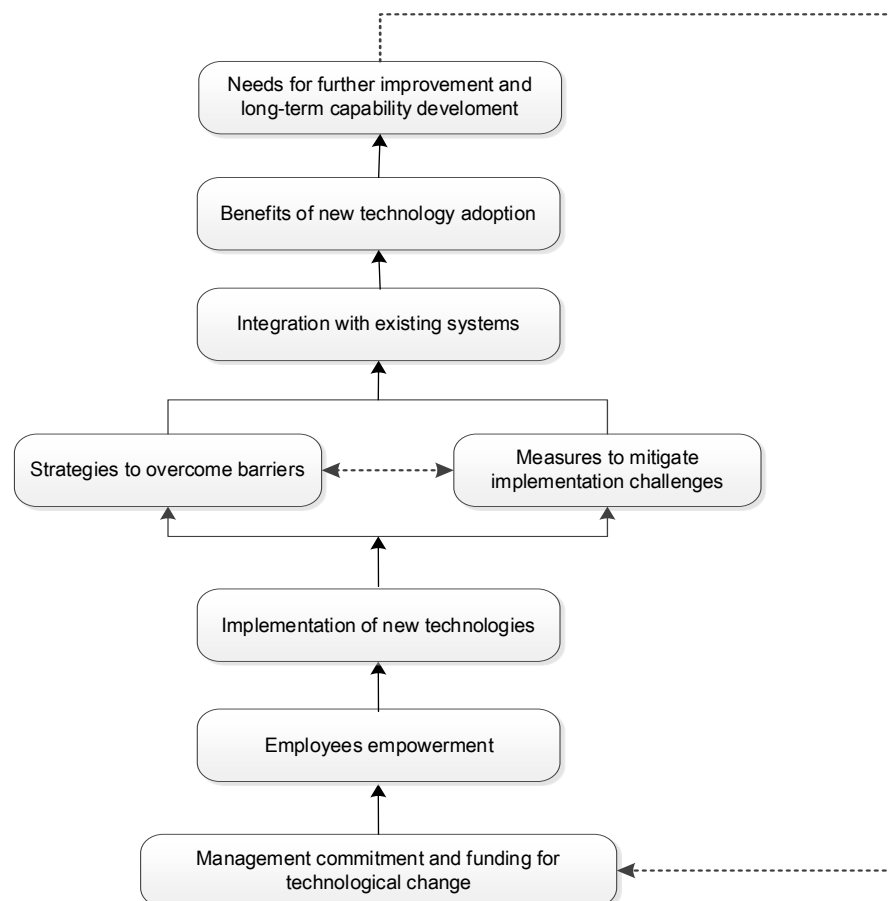

FIGURE 3 – CONCEPTUAL MODEL FOR NEW TECHNOLOGIES ADOPTION

5. CONCLUSIONS

Industry 4.0 is a concept that enables digital transformation, through which advanced technology is integrated into business processes, and it represents a direction for the modernization and development of IT companies in North Macedonia. The research delivers various insights related to the level of acceptance of these technologies, the challenges that IT companies face, and the effects of the utilization of Industry 4.0 technologies on overall organizational performance improvement. The results of the conducted survey indicate that all the surveyed companies integrated digital technologies fully or partially. Actually, none of the respondents selected the remaining optional statuses – *"In pilot phase", "Planned for future",* or *"Not integrated at all".*

As a result, the assessed high technological maturity, digital conscience, especially in the area of security, flexibility, and intelligent resource management, can be underlined. Furthermore, the diversity of barriers during the implementation process and the obstacles encountered during the utilization of new technologies were surveyed. The survey findings indicate the crucial role of human capital in the process of digital transformation. In terms of the beneficial aspects, the automation and increased companies' productivity were pointed out. In addition, the financial perspective was assessed, with accurate allocation of budgets to digital technologies. This perspective indicates the huge differences among companies' financial potential and ability to adopt the new technologies driven by various levels of integration. Summing up the research, it can be concluded that Industry 4.0 plays a pivotal and transformative role in the Macedonian IT sector. With strategic managerial commitment, by including financial incentives support, measurement of key performance indicators, development of training programs, and building organizational culture for innovation cultivation and nurturing, the IT companies' competitiveness can be increased. Based on the survey findings, the conceptual model for simplification of the adoption of new technologies within the companies was created. Generally, the digital growth of the IT sector can exceptionally contribute towards the overall economic development in the country. In other words, Industry 4.0 has vast potential to transform IT companies, through various means such as productivity, quality, and competitiveness. Therefore, the integration of Industry 4.0 should be understood as a necessity rather than a choice, just because of its colossal potential.

5.1. Research Limitations

First, the limitations of the research are in line with future expectations. In fact, this research is limited only to IT companies and it is clear that there is potential to expand to other industries in North Macedonia. Second, the response rate in the research is 63%, but it could have been higher. Third, the number of respondents could be increased by increasing the focus groups by including more countries in the region. In this way, a comparison between IT industries would be possible, which would certainly be useful for

expanding the framework of the environment in which Industry 4.0 technologies are practiced in the IT business sector community.

5.2 Further Avenues of Investigation Suggested

Further research can be extended to a more extensive analysis of various industries, such as the food industry, automotive industry, pharmaceutical industry, etc. Firstly, the collected data within the particular industry can be analyzed, and then, the data can be compared among the selected industries, according to defined criteria.

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