

VALUATION OF THE EFFECTS OF EMERGING TECHNOLOGIES: SURVEY-BASED EVIDENCE FROM THE IT SECTOR

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ABSTRACT

Understanding the potential of emerging technologies to accelerate economic growth, competitiveness, and sustainability, this paper evaluates their effects on business performance within the Information Technology (IT) sector. Additionally, the study investigates the level of integration of these technologies into the business operations of IT companies in North Macedonia. A quantitative survey was conducted using a structured questionnaire distributed among selected IT companies. The research findings indicate that the integration of new technologies significantly enhances business performance and operational efficiency in the Macedonian IT sector, with Cloud Computing and Cybersecurity showing the highest level of adoption maturity, while AI, ML, Big Data, and IoT demonstrate varying levels of implementation and impact. The present study is a contribution to building a knowledge base on what is currently taking place in the IT sector with respect to embedding emerging technologies into its business models. As innovations continue to alter business operations, marking a new era in which emerging technologies effortlessly integrate with traditional practices, their influence remains a determinant of success.

Keywords: Emerging technologies; Effect; Integration; IT Companies.

INTRODUCTION

Emerging technologies present unparalleled opportunities for a prosperous future, now and in times to come, by rewiring the way businesses operate. These developments refer to a chain of technologically advanced factors alongside Internet of Things (IoT), Artificial Intelligence (AI), Cybersecurity, Machine Learning (ML), and Cloud Computing, which allow organizations to redesign their business models. As important participants in economic progress, companies are able to utilize these opportunities to improve efficiency and productivity, thereby becoming more competitive, especially within in the IT sector (Dimovski et al., 2026). By embracing emerging technologies, IT companies have the opportunity to optimize processes, minimize costs, and provide customers with more personalized goods (Bakator et al., 2024). Generally speaking, organizations that have embedded innovative technologies experience success in the digital era (Agustian et al., 2023).

Although the positive effects of emerging technologies have been well documented, their implementation and level of integration are not sufficiently understood or widely applied, especially in developing countries. Therefore, investigating driving technologies and their impact on specific businesses' performances, emerges as a major research incentive of this paper. Exactly, the research problem focuses on the following goal:

G1: To evaluate the effects of embraced emerging technologies on the specific businesses' performances in the Macedonian IT sector."

The additional research goal in this paper is:

G2: To investigate the level of integration of these technologies in the current operations within the IT companies.”

In fulfilling the research goal, the proposed research design combines a qualitative approach (literature review) with a quantitative method (survey). The paper is structured into several sections, the literature review, methodological framework, findings and discussion, and the final section offers the conclusion.

LITERATURE BACKGROUND

Apparently, companies that integrate emerging technologies in their organizational structure are more competitive on the market (Perifanis and Kitsios, 2023; Lindström et al., 2023). More than a few studies have suggested that the adoption of advanced technologies has a positive influence on performance (Agustian et al., 2023; Yuniarto, 2023). Consequently, organizations become flexible enough to face any changes in the marketplace, particularly in the case of IT companies, which belong to fast-growing industries (Ibrahim and Ali, 2023; Stanojeska, 2024).

As stated by Sharma et al. (2023), the importance of Cloud Computing is determined by its scalability, flexibility, and efficiency due to being less expensive. Likewise, Khatib et al. (2019) acknowledge the cost-efficiency of the technology along with the opportunities for having access to computing services whenever necessary. The application of Big Data is crucial because of the need for data transformation into valuable information and the ability to develop forecasts and make decisions, as underlined by Rane et al. (2024). Moreover, the role of IoT is associated with efficiency and automation due to the ability to collect and process information in real time from connected devices (Rocha & Kissimoto, 2022). It can be concluded that the combination of AI and IoT allows for predictive maintenance and improved decision-making (Gajić et al., 2024; Reim et al., 2020). Additionally, ML and AI enable predictive analytics, automation, and personalization (Brocal et al., 2019; Stanojeska, 2025; Waqar et al., 2024). AI provides more value to customers via personalized services and smarter decision-making, while ML algorithms improve efficiency by automating mundane tasks and optimizing resource consumption (Chowdhury, 2024). According to Rocha & Kissimoto (2022), the full potential of both AI and ML technologies remains unexplored, thus necessitating empirical research in this area. Aspects of Cybersecurity have been identified as one of the most important elements in facilitating digital transformation in today's world, as they ensure data privacy, system integrity, and organizational sustainability (Hasan et al., 2021; Lezzi et al., 2018). Thus, the effective Cybersecurity measures can be useful in securing information assets (Denkovski et al, 2024; Hasani et al., 2023).

In conclusion, it has been proven that all the technological innovations that define emerging technologies help increase efficiency and innovation while improving competitiveness. At the same time, their benefits are best achieved through integration instead of implementation separately. Although the literature review has provided valuable information, a significant deficiency has been noted in the number of studies examining the level of integration of emerging technologies and their effects on business models in Macedonian IT companies.

RESEARCH METHODOLOGY

In line with the research goals, the applied methodology employs a qualitative research method and quantitative analysis. In terms of the qualitative research, a comprehensive research of the literature based upon Emerald, Scopus, EBSCO, and other relevant bases, was conducted in the period from 1st January 2025 to 15th February 2025. A total of 22 papers in the treated areas, published in English, have been found, according to keywords: emerging technologies, effect, business performances, and IT industry. The quantitative research was conducted through a survey using a structured questionnaire.

Questionnaire design

The survey conduction includes the design of a structured questionnaire composed of questions referring to the determined specific criteria, offering multiple categories of optional answers in accordance with the research objectives and allowing the selection of more than one answer.

The questionnaire encompasses 18 questions positioned in 3 sections: (I) referring to general data about respondents, (II) covering benefits, and challenges of emerging technologies implementation in the IT companies and (III) referring to effects of emerging technologies on specific business performances and the level of integration of new technologies in the current operations. General data were gathered at the start of the questionnaire in the first section, including company name, type of company activity, number of employees in the organization and responder position.

The second section addresses benefits and challenges before and during the implementation of emerging technologies in IT companies. The findings regarding the second section were published in the paper titled *"Industry 4.0 in Practice - Exploring the challenges of adoption in the IT sector,"* in Journal of TERUM (Dimovski et al., 2026). The third section includes questions concerning the effects of emerging technologies on specific business performances and the level of integration of new technologies in existing processes. Actually, the research in this paper embraces the findings regarding the third section of the questionnaire.

Data collection

The data were collected from 40 reputable IT companies in North Macedonia, that were actively involved in software development and digital technology services. Companies were identified based on their market presence, operational activity, and relevance to the research topic. Invitations to participate in the survey were distributed to representatives of 40 selected IT companies during the period from 1st February, 2025 to 1st March, 2025. The response rate was 78%. 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). Specifically, this survey contains a wider scope of job positions of the respondents, 36% were software developers, followed by managers with 24%, 12% software engineers, 12% business owners, 4% for software testers, 4% web developers, and finally, 4% team leaders. This research and its findings are limited to the Macedonian IT companies (as a representative example of a small developing country), but can still indicate the general directions concerning its research goals.

RESULTS AND DISCUSSION

In more detail, the specific effects of six technologies on certain criteria were explored throughout the survey conducted in the IT sector. Thus, respondents were challenged to evaluate (1) the impact of using Cloud Computing from a resource management perspective, (2) the effect of Big Data technology on data-driven decision making, (3) the impact of using IoT in businesses process automation and optimization, (4) the usability of ML to predict customer needs, (5) the integration of AI technology in customization and personalization efforts, and finally (6) the effect of using Cybersecurity technology to address the risk of data privacy and security infringements. The collected data are explicitly presented in Table 1.

The general conclusion is that the claims listed in Table 1 are more or less confirmed by the respondents included in the survey. It is clear that *Cybersecurity* and *AI* are the highest-ranked technologies according to the criterion of application and understanding of their effects in terms of information protection and automation of operations, respectively. This proves a strong awareness among companies of the importance of cybersecurity and its main role in reducing company vulnerabilities and preventing potential attacks. In the same context, the power of AI is recognized by

as many as 92% of the surveyed companies, according to which AI is the driver of automation in performing complex operations and personalization in response to individual customer requests. A minor number of respondents chose the option of “*lack of information*”, which leads to the conclusion that Cybersecurity and AI are well understood in domestic IT companies.

Table 1: Overview of data collected throughout the survey

Research question: Effect of...	Collected data (%)			
	Significantly positive impact	Slightly positive impact	No impact	Lack of information
...Cloud Computing on resource management	44	41	0	15
...Big Data on data-based decision making	46	15	0	39
...IoT on automation and optimization	46	35	0	19
...ML on customers needs prediction	54	27	8	11
...AI on customization and personalization	54	38	4	4
...Cybersecurity on data privacy protection	80	16	0	4

A lower portion of respondents (under 20%) stated that they are not familiar with the functionalities and effects of *ML*, *Cloud Computing* and *IoT*, which leads to the conclusion that employees have not yet had the opportunity to gain work experience in the application of this type of advanced technologies.

More critical findings were obtained regarding the impact of *Big Data* on data-driven decision-making. The fact that as many as 39% of the respondents stated that they do not have enough information to assess the effects of Big Data in practice is impressive. This finding is significant and indicates a serious need for employee education and raising their knowledge, through organizing specialized training programs for systematized development, in order to recognize the role of advanced technologies and their effects in improving organizational performance.

The next research goal concerns the investigation of the degree of support of current operations in IT companies enabled by specific emerging technology (*Cloud Computing*, *Cybersecurity*, *IoT*, *AI*, *ML*, and *Big Data*). For the purpose of data simplification, the support levels are divided into five intervals (0-20%, 20-40%, 40-60%, 60-80%, and 80-100%). Analyzing each specific technology, presented in Figure 1, the following conclusions were reached.

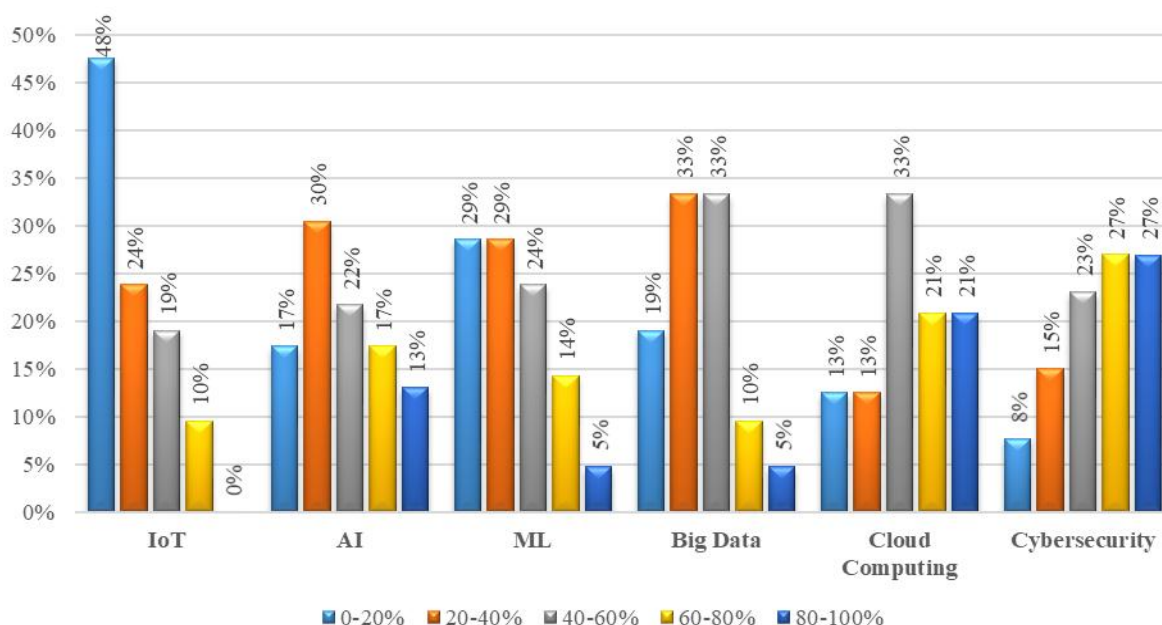


Figure 1: Level of integration of emerging technologies within IT companies

According to the given findings, none of the respondents confirmed that IoT supports current operations to a significant extent, at the highest level of integration (80-100%). In contrast, the majority of the responses are addressed to the lowest level of integration (0-20%). It is more than clear that IoT is poorly adopted in the IT sector.

Regarding AI, at the highest level of integration, only 13% of respondents consider AI vital for personalization in meeting customer requirements. Accordingly, the integration of AI is on the rise, but is not yet at an enviable level. A similar view can be confirmed for ML and Big Data. In other words, as the level of integration increases, the application of ML and Big Data in current operations decreases. Hence, the conclusion is that these technologies have moderate application in the IT sector and their potential is not yet fully utilized in current operations.

In contrast to AI, Big Data, and IoT, the data analysis leads to the conclusion that Cloud Computing is adopted to the greatest extent in IT companies (in the range of 40-100%). In terms of Cybersecurity, it is worth emphasizing that as many as 27% of the surveyed companies have a very high level of protection that varies in the range of 60-100%, and only 8% of the companies apply it for security and data protection that are at the first level of integration. This implies the claim that, as the level of integration of new technologies into companies' business models increases, so does the awareness of the need to practice Cybersecurity.

Overall, the data presented in Figure 1 confirms that Cloud Computing is the leading technology in terms of the level of integration of emerging technologies into the current operations of IT companies. Cybersecurity is second in line, while other technologies, such as AI, ML, and Big Data, are utilized, but only partially. Compared to other emerging technologies, it is notable that the use of IoT as a technology that enables automation and optimization of business operations is the least adopted in IT companies.

CONCLUSION

The adoption of emerging technologies offers significant benefits and improvement in overall business performance, which is confirmed by the findings of the conducted research. The significantly positive effect of the application of emerging technologies in resource management, automation and optimization, personalization and customization, protection of private data, as well as the prediction of customer needs, is clearly confirmed by the majority of the analyzed data. The survey showed that the application and integration of new technologies in Macedonian IT companies are at different levels, depending on the type of technology and the level of understanding of its effects on organizational operations. As the results indicate that the degree of adoption of new technologies is not equally distributed, there are technologies that already have strong practical application, like Cloud Computing and Cybersecurity, while others are still in the phase of partial adoption or limited integration. These findings emphasize the need for strategic investments in staff training, technological infrastructure and the development of innovative business models, in order to more fully exploit the potential of new technologies and improve organizational performance and competitiveness of the IT sector. Thus, it can be concluded that the adoption of emerging technologies cannot be taken as an option but must be done out of necessity, because of the significant possibility for sustainable development and global competitiveness in the IT industry.

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