Korcsmáros, E., Seres Huszárik, E., Tóbiás Kosár, S., Gódány, Z., & Csinger, B. (2025). Technological development as a key in various sectors of SMEs. *Journal of International Studies, 18*(2), 120-137. doi:10.14254/2071-8330.2025/18-2/7

Journal of International Studies

Centre of Sociological Research

Scientific Papers

Technological development as a key in various sectors of SMEs

Enikő Korcsmáros
Department of Economics and Management, J. Selye University, Slovakia
korcsmarose@ujs.sk
ORCID 0000-0002-2026-8712

Erika Seres Huszárik
Department of Economics and Management, J. Selye University, Slovakia
huszarike@ujs.sk
ORCID 0000-0002-6842-1579

Silvia Tóbiás Kosár
Department of Economics and Management, J. Selye University, Slovakia
kosars@ujs.sk
ORCID 0009-0005-8772-6836

Zsuzsanna Gódány
Department of Economics and Management, J. Selye University, Slovakia
godanyz@ujs.sk
ORCID 0000-0002-2391-1638

Bence Csinger
IREKS-STAMAG Kft, Hungary
csinger.bence@gmail.com
ORCID 0000-0002-1348-4660

Abstract. Background: Small and medium-sized enterprises (SMEs) are an indispensable part of the global business sector and play a vital role in economic development. However, technological advancements often pose significant challenges for SMEs, as they frequently struggle to keep pace with technological changes due to limited resources and expertise. The intensity of technological development in SMEs is influenced by numerous factors, irrespective of

Received: May, 2024
1st Revision: February, 2025
Accepted: June, 2025

DOI: 10.14254/2071-8330.2025/18-2/7

changing market and environmental conditions. Methods: The purpose of this study is to highlight the importance of technological developments across various sectors of SMEs, with particular attention to the effects of multiple parameters - such as company size, sales revenue, operational area, and location - on technological advancement. The study examines the corporate characteristics present in the activities of SMEs that determine technological development, as well as their relationship with operational and development practices. Results: The findings from international studies and our own research analysis support the conclusion that, within the investigated sample, company size significantly influences the technological developments implemented. Furthermore, our results demonstrate that, due to the simplicity, flexibility, and lower cost of various technological devices, solutions that were once exclusive to large companies are now accessible to SMEs. Conclusions: With regard to the development of introduced technologies, the study finds that as company size increases, it is more common for firms to implement entirely new technological solutions rather than merely innovating or expanding existing technologies to a lesser extent.

Keywords: technological development, digital technologies, SMEs.

JEL Classification: O32, M19, M29

1. INTRODUCTION

In today's world of international business and global markets, technology has become a crucial tool for boosting market competitiveness. Worldwide expansion has significantly transformed the economic and business landscape of a country. Many companies have seized opportunities to achieve economies of scale. The development of the knowledge economy and high technology inextricably links to the development of the competitiveness of small and medium-sized enterprises (SMEs). International research related to the SME sector clearly highlights the role of technological innovations, or their application in terms of companies' competitiveness. This was the main motivation for researching the relevance of the international trend for the population we examined. In the study, after reviewing the relevant literature related to the research area, we discuss the methodology and method of the research. When evaluating the results of the research, we examine the relevance of the formulated hypotheses and then draw conclusions.

The main goal of our research is to reveal the importance of technological developments in the various sectors of small and medium-sized enterprises, with particular regard to the effect of various parameters influencing technological developments - such as company size, sales revenue, operational area, location. After studying the extensive theoretical background, we formulated hypotheses related to the researched problem, which are as follows: A statistically provable difference can discovere between the SMEs that implemented technological development in the last 5 years based on their different size, sales revenue and the technological nature of the development. Factors that encourage the implementation of technological development influences by both company size and the company's field of operation.

After the analysis of the data obtained during the primary data collection, it can be concluded that as the size of the company increases, the introduction of a completely new technological solution is more typical for companies than innovation or expansion.

2. LITERATURE REVIEW

During our research, we assessed the importance of technological developments among small and medium-sized companies operating in various sectors. The relevance of the study is justified, among other things, by the fact that technology is increasingly present in the small and medium-sized enterprise sector, which only further strengthens the vast, broad expansion of the possibilities offered by technical achievements as a result of the measures due to COVID-19. The originality and importance of the study lie in the fact that it dissects a particularly current topic from a perspective that has so far has received less research in the context of international comparisons, so the research results can complement the previous findings nicely. In developing the theoretical background of the study, we relied on relevant and current domestic and international literature, most of which we searched from scientific domestic and international databases (WoS, Scopus). The literature review provide a critical and comprehensive review on the topic of SMEs and technological development. After the review of the literature, the purpose of the research, the methodology used, and the results of the research and the discussion present. The study ends with conclusions.

SMEs usually have strong competitors within the sector, including an appropriate legal framework (Dvorsky et al., 2023). Industries with a high level of technological development also exhibit high-intensity research and development activities. (Vravec, 2017) Technological development can also affect corporate reputation, which - as pointed out by Blajer-Golebiewska and Vasa (2024) - has had a positive effect on business performance in all business sectors. Belás et al. (2020) point out that, depending on the industry represented, one can identify significant differences between the companies of the Slovak SME sector in terms of the companies' perception of the business environment. However, the technological revolution poses significant challenges to small and medium-sized enterprises. Technological development is key in making small and medium enterprises (SMEs) competitive and sustainable growth (Tripathi-Brahma, 2018). Small and medium-sized enterprises (SMEs) play a crucial role in promoting the development of the world economy. The main obstacles facing SMEs are the risk of higher costs, the entrepreneur's lack of time and motivation, the lack of human resources, and bureaucratic barriers (Betakova-Pietrzak-Iglinski, 2023). With the creative processes of this business sector, they contribute significantly to the economy, stimulating the development of technology, corporate innovation, job creation, income generation, economic competitiveness and other aspects of social development in general, with particular regard to industrial expansion. Although small and medium-sized enterprises are the backbone of the economy, a widespread, a pervasive, a prevalent problem of SMEs is their extremely high sensitivity to market changes. In the current environment, it is challenging for SMEs to keep up with the extremely rapid technological development. We can state that requires constant coordination with international customers to understand their changing needs to produce products that meet global standards. "In addition, companies need detailed real-time information on the product and service offerings of foreign industries for market competitiveness." The technological environment, more precisely digital transformation initiatives, supports the development and adoption of new technologies, which play a crucial role in making small and medium-sized enterprises competitive and sustainable (Das et al., 2020).

Small and medium-sized enterprises have a significant impact on the economic development of a country. SMEs create jobs, compete with large companies and become part of the global market (Myslimi-Kacani, 2016). The existence of these enterprises is the pride of every country, as these SMEs play an essential role in economic development and growth. Small and medium-sized enterprises are remarkable drivers of economic development (Obi, 2018). They are vital to most economies worldwide, especially in developing and emerging countries (Ndiaye et al., 2018). These companies make up 99% of all businesses in the European Union (European Commission, 2020). Unlike large enterprises, businesses belonging to

the SME group are highly, incredibly flexible. They show excellent flexibility in the face of technological changes, better promote income distribution and better adapt to market fluctuations and new customer needs. At the same time, their corporate structure enables faster decision-making (Perez-Gomez et al., 2018). However, to understand this potential, SMEs need a continuous, long-term funding source to invest in growth opportunities (Dowling et al., 2019). SMEs considerthe backbone of the economy (Yoshino-Taghizadeh-Hesary, 2019), as they play a significant role in reducing poverty, creating jobs, promoting foreign trade and technological innovation, and they contribute significantly to the growth of developing economies (Luo et al., 2016). Small and medium-sized enterprises are becoming increasingly pivotal in market development and drive sustainable growth across trade, production, and service sectors (Sipa et al., 2015). In addition, these companies are the main drivers of annual GDP growth per capita (Aladin et al., 2021). SMEs are an essential tool in realising more inclusive globalization and growth. In their study, Rentková and Gejdoš (2019) point out that, thanks to SMEs in the regions, it is possible to increase employment, regional GDP and regional incomes. The analysis of the number of SMEs created and closed in each area is also an essential element, which points to the business environment of the areas (regional, national) as well as the educational level (level of financial and entrepreneurial skills). Statistics show that 8 out of 10 companies established in Slovakia survive the first year, but only 5 survive the fifth year. Since regions gain a competitive advantage thanks to the activity and existence of SMEs, it is not surprising that European cohesion policy supports the creation and maintenance of SMEs. Overall, small and medium-sized businesses are the leading players in the economy and the vast ecosystem of companies. They also play a crucial role in achieving the Sustainable Development Goals (SDGs) and in fostering inclusive and sustainable economic growth, employment, and reducing income inequality globally. The development of SMEs can promote economic diversification and flexibility, which is especially important for resource-rich countries sensitive to changes in commodity prices. The contribution of small and medium-sized enterprises to innovation dynamics in recent decades has been driven by the knowledge-based economy (Bayraktar-Algan, 2019; Zsigmond and Mura, 2023).

The rapid technological development of the past decades had and still has an impact on the business world. Alongside large companies, small and medium-sized enterprises must also prioritize the use of suitable technology to enhance their competitiveness (Nugroho et al., 2017). Currently, businesses operate in a rapidly changing environment and must continuously evolve to keep up. The needs and preferences of consumers and the expectations of the products/services provided by businesses are constantly changing. Owners and managers of companies must make decisions in an uncertain environment while making the most of limited resources. To remain competitive, firms must ensure and maintain technological change to gain information about future technology while developing asset maintenance and replacement strategies (Nguyen et al., 2017). Small and medium-sized enterprises contribute to the economy worldwide. The GDP of almost every country depends on the performance of small and medium enterprises (Kumar-Ayedee, 2018). The adopting and application of technology can make a difference for SMEs. The COVID-19 pandemic also proved that the adoption of technology is not an option. It is an essential requirement for small and medium-sized enterprises (Kumar et al., 2020). Technology can be understood as an investment in a business to achieve a competitive advantage (Afenya et al., 2019). Technology is changing rapidly, and businesses must keep pace to survive in a competitive business environment. Companies face various challenges and constantly innovate to remain competitive. One way of innovation is incorporating new technologies into company processes (Yu-Schweisfurth, 2020; Mishchuk et al., 2021). The technological environment, particularly through digital transformation initiatives, fosters the development and adoption of new technologies, which are crucial for making SMEs competitive and sustainable (Das et al., 2020). Digital tools bring many significant benefits to companies. Digitization reduces transaction costs by providing better and faster access to information and facilitating

communication between employees, suppliers and different networks. It can also aid SMEs in entering global markets by cutting costs related to transportation and border procedures, while significantly boosting trade in services. It also enhances access to resources, including funding options like peer-to-peer lending, as well as training and recruitment channels, and government services that are increasingly offered online. It also supports greater access to innovation tools and the ability of companies to generate data and examine their operations in new ways to achieve better performance (OECD, 2021). Adopting technology can give companies a competitive advantage over their competitors (Andaregie-Astatkie, 2022; Tutar et al., 2024). Nowadays, the digital transformation of businesses plays a crucial role in economic changes and is also a source of competitiveness (Ollo-López-Aramendia-Muneta, 2012; Nekmahmud-Rahman, 2018; Bilan et al., 2023). In this way, technology builds the competitiveness of small and medium-sized enterprises in emerging economies and facilitates the simplifies of decision-making processes. Adopting digital technology can enhance SMEs' ability to manage information flow, lower operating costs, and improve quality, thereby providing a competitive edge (Taruté-Gatautis, 2014; Zide-Jokonya, 2022). In addition, investment in technology increases corporate capabilities and significantly affects internal and external communication (Bayo-Moriones et al., 2013).

Several research has demonstrated that the strategic and effective adoption of digital technologies can boost the competitiveness, productivity, and performance of SMEs (Bruque-Moyano, 2007; Dibrell et al., 2008; Kleis et al., 2012; Chan et al., 2019). Nuseir and Aljumah (2020) also found that digital technologies can enhance a company's business performance. Other studies (Mazzarol, 2015; Octavia et al., 2020) also indicated that the capacity to adapt to and effectively utilize digital technologies significantly influences the performance of small and medium-sized enterprises. The application of digital transformation is more concentrated in specific sectors of activity (Nadeem et al., 2018). As a result, the digital transformation differs depending on the company's scope of activity. The digital transformation of enterprises depends on factors other than the business sphere: the constantly changing needs of consumers, the level of application of high-tech technologies, the company's leadership position and the size of the enterprise (Taruté et al., 2018). Companies leading in digitization tend to achieve higher revenue and productivity over the long term compared to those that are less digitally advanced (OECD, 2018). Overall, we can say that the rise of digital technology has created a transformative market opportunity that companies across various sectors are exploring and leveraging to gain significant benefits (Kane et al., 2015). It affects user interaction, customer interfaces and internal processes at all company levels (Kane et al., 2015; Sugathan et al., 2018). Kane et al. (2015) highlighted in their research that the capabilities of emerging technologies now extend beyond products, market operations, distribution platforms and supply chains. To adapt to these changes, companies must digitally transform their business models, core processes, operational structures, and management practices (Chytilová et al., 2024; Matt et al., 2015; Kane et al., 2015). However, one of the most significant obstacles facing businesses today is adopting of emerging digital technology. Several factors can account for this. Without claiming to be exhaustive, these factors are the emerging society, which necessitates the development of emerging technology and its ability to enter the market quickly; increased competition due to globalization; and increased consumer expectations due to increased competition (Kane et al., 2015). According to Pelletier and Cloutier (2019), small and medium-sized enterprises have better access to fully integrated digital tools that help them perform business functions such as marketing, finance and accounting, and human resources. These technologies are present in companies to simplify management procedures and improve relationships with consumers and suppliers. In addition, digital transformation also plays a vital role in information acquisition and corporate networking. It promotes early and rapid worldwide integration by creating an environment in which young exporters can learn quickly (Pagani-Pardo, 2017). For this reason, researchers mention digitization as a way for small and medium-sized enterprises to enter the international market. In closing, however, it

cannot go without saying that the digital transition requires significant investment due to the high costs of introducing digital technology (Chosin-Ghaffari, 2017). As SMEs do not have enough time for trial and error, it is essential to consider the effects of digitization to make results-based decisions (Wilden et al., 2013; Krammer et al., 2018). In their research, Snieška et al. (2020) examined the technological, information and innovation risk in connection with Industry 4.0 in the Slovak SME sector. According to their conclusion, the introduction of Industry 4.0 will likely bring about new risks for SMEs, which could negatively affect companies in various ways. Representatives of the SME sector will not take advantage of the potential of Industry 4.0 until all its risks are well understood and assessed. Moreover, enterprises in some Central European countries, such as Slovakia, have not considered the challenges of Industry 4.0 for a long time and are therefore lagging behind Western European countries. The most essential attribute of the sustainability of SMEs is the economic field, which determines the companies` approach. If SMEs can survive in a robust competitive environment despite various economic and social difficulties, their interest in social and environmental issues will also increase (Khan-Akhtar-Vishwakarma-Hoang, 2023).

3. METHODOLOGY AND RESEARCH PURPOSE

The main goal of the research is the analysis of issues related to the development of technology that currently occupy all categories of companies, as well as the exploration of good corporate practices. The target population of the study was small and medium-sized companies. The primary objective was to investigate the traits of companies across different sectors in relation to technological advancements. Researchers can establish specific objectives as sub-goals to address more complex research questions. These include exploring the factors that drive technological developments and analyzing how sales revenue, company size, location, and operational area impact technological advancements.

The research assessed the importance of technological developments among small and medium-sized companies operating in various sectors. For this purpose, and among the research methods relevant to the examined problem area, the sample data used as the basis of the practical examination collect using an online query. Before the query, We used several scientific databases in the second half of 2023 to identify the literary sources underlying the topic. We used the method of critical selection to choose the literary sources.

During the online questionnaire survey, we collected a large amount of data in a relatively short time. However, this observation method did not enable us to gather sensitive quality data. The questionnaire used during the questionnaire survey contained groups of questions related to the companies' data, technological developments and competitiveness, as well as the personal characteristics of the respondents. The proportion of small and medium-sized enterprises represented in the examined population does not fully reflect the proportion of SMEs at the national level. Still, overall small and medium-sized enterprises make up 76% of our sample.

The research targeted small and medium-sized enterprises in Slovakia and Hungary. As the basis of the test sample, we created a separate database of the companiesoperating in Slovakia and Hungary We selected the contact information in the databases of various national collection sites. Thus, we aggregated the data of a total of 2648 companies. Among the sampling procedures, we used the random stratified sampling procedure, and we used the location of the enterprises as the stratifying variable. Based on the complete responses received, we found that 10.7% of the contacted companies were willing to complete the questionnaire.

The questionnaire used in the research featured both single and multiple-response questions, as well as Likert-scale statements. Respondents could use these statements to describe various characteristics of

their organization on different topics. Respondents could indicate their position on a 4-point scale in the case of scaled questions.

The research question on the basis of which we formulated our hypotheses was the following: How do the company's characteristics influence technological developments?

By processing the theoretical sources and secondary data, as well as the propositions to be proven based on the researchers' practical experience, using the method of inductive hypothesis formulation, we formulate the following hypotheses in the research:

H1: We can discover a statistically significant difference between the SMEs that implemented technological development in the last five years based on their different size, sales revenue and the technological nature of the development.

H2: Factors that encourage the implementation of technological development influences by company size and the company's field of operation.

145 companies located in Hungary and 130 in Slovakia participated in our analysis. Before analyzing the data collected during the survey, we coded it using the SPSS statistical program and excluded incomplete or partially completed answers. We primarily used descriptive statistics for the data from the evaluable questionnaires collected during the primary research, and then we used bivariate and multivariate data analysis to test our hypotheses. Before testing the hypotheses, we outline, we examine our n variables about the standard method bias problem (CMB).

4. EMPIRICAL RESULTS AND DISCUSSION

Out of the 281 people in the sample, we classified 275 companies from Hungary and Slovakia as micro, small, and medium-sized enterprises. Among these, 227 companies underwent technological development in the last five years. In the following, we examine the data of these companies when testing our hypotheses.

H1: A statistically provable difference can discovere between the SMEs that implemented technological development in the last five years based on their different size, sales revenue and the technological nature of the development.

According to our hypothesis H1, we can make a distinction between SMEs that have carried out technological development in the last 5 years based on company size and sales revenue and based on the nature of technological development. The technological development included in the hypothesis can considere nominal variable, the attributes of which in the questionnaire are "Introduction of a completely new technology, Significant renovation of current technology, Minor conversion of current technology."

Companies had to choose one of these options. The company`s size was measured by comparing the number of employees and the sales revenue using intervals related to sales revenue. During our analysis, we first looked at the distribution of sales revenue.

Table 1

Distribution of micro, small and medium-sized enterprises based on sales revenue

	Microenterprise	**Small Enterprise**	**Medium-sized enterprise**
Under 50 thousand euros	38%	10%	2%
50-100 thousand euros	26%	12%	0%
101-1 000 thousand euros	31%	32%	13%
1001 thousand-10 million euros	4%	45%	41%
Over 10 million euros	1%	1%	44%

Source: own editing based on primary research.

As can be seen in Table 1, sales revenue increases as a function of company size. We observe that for micro-enterprises, the top three sales categories are under 50,000 euros, 50,000 to 100,000 euros, and 101,000 to 1,000,000 euros. For small businesses, the sales range extends from 101,000 euros to 10 million euros. Finally, 85% of the medium-sized enterprises in the sample typically have sales revenues ranging from 1,001 thousand euros to more than 10 million euros. After the univariate analysis, we examined the relationship between company size and technological development.

Table 2

Distribution of micro, small and medium enterprises based on the nature of technological development

	Completely new technology	**The major innovation of current technology**	**Minor renovation of current technology**
Microenterprise	19%	26%	55%
Small Enterprise	23%	33%	44%
Medium-sized enterprise	24%	48%	28%

Source: own editing based on primary research.

Table 2 illustrates the relationship between company size and technological development. After performing the univariate analysis, it seems that as the size of the company increases, complete technological innovation is more common among companies. At the same time, the small-scale innovation of the current technology decreases.

After performing the cross-tabulation analysis, with the help of the Chi-square test at a significance level of 5%, we examined whether we can demonstrate a statistical correlation between the size of the company and the nature of technological development. We summarize our research results in Table 3.

Table 3

Chi-Square Tests (company size, nature of technological development)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.466[a]	4	.033
Likelihood Ratio	10.612	4	.031
Linear-by-Linear Association	5.614	1	.018
N of Valid Cases	227		

Source: own editing based on primary research.

The table shows that the significance level is below 5%, indicating a significant correlation between the two variables. Given these insigths it means that the size of the company influences the type of development undertaken by the SMEs. After establishing the existence of the relationship, we examined how strong it is between the two variables. Table 4 illustrates the strength of this relationship.

Table 4

Symmetric Measures (company size, nature of technological development)

		Value	Approx. Sig.
Nominal by Nominal	Phi	.215	.033
	Cramer's V	**.152**	.033
	Contingency Coefficient	**.210**	.033
N of Valid Cases		227	

Source: own editing based on primary research.

The table reveals that both Cramer's V and the Contingency Coefficient values indicate a weaker-than-average significant relationship between the two variables in both cases.

Based on the results so far, we can conclude that there is a weaker-than-average considerable relationship between company size and the nature of technological development, so about the first half of our research hypothesis, we can say that with the increase in company size, it is more typical for businesses to use completely new technologies than existing technologies of more minor nature development.

In the following, we focus on testing the second half of our first hypothesis, examining the relationship between sales revenue and the nature of technological development.

The results of Table 5 how technological development progresses in relation to sales revenue.

Table 5

Distribution of companies based on the nature of technological development, taking into account sales revenue

	Completely new technology	**The major innovation of current technology**	**Minor renovation of current technology**
Under 50 thousand euros	10%	28%	62%
50-100 thousand euros	19%	31%	50%
101-1 000 thousand euros	18%	32%	50%
1001 thousand-10 million euros	39%	34%	27%
Over 10 million euros	8%	54%	38%

Source: own editing based on primary research.

The table clearly shows that up to 10 million euros, the introduction of completely new technology shows an increasing trend among companies, but above that, the companies strive to significantly renew the current technology After conducting the cross-tabulation analysis and using the Chi-square test at a 5% significance level, we investigated whether a statistical correlation exists between sales revenue and the nature of technological development. We summarize our research results in Table 6.

Table 6

Chi-Square Tests (sales revenue, nature of technological development)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.673[a]	8	.001
Likelihood Ratio	26.295	8	.001
Linear-by-Linear Association	9.407	1	.002
N of Valid Cases	227		

Source: own editing based on primary research.

The table shows that the significance level is below 5%, indicating a significant correlation between the two variables. The results means that the company's sales revenue, as an independent variable, influences the nature of the implemented technological innovation, the dependent variable. After confirming the existence of this relationship, we examined the strength of the correlation between the two variables. Table 7 illustrates the strength of this relationship.

Table 7

Symmetric Measures (sales revenue, nature of technological development)

		Value	Approx. Sig.
Nominal by Nominal	Phi	.343	.001
	Cramer's V	**.242**	.001
	Contingency Coefficient	**.324**	.001
N of Valid Cases		227	

Source: own editing based on primary research.

The results of Table 7 shows that both Cramer's V and the Contingency Coefficient values indicate a below-average significant relationship between the two variables in both instances. Based on the results so far, we can conclude that there is a weaker-than-average considerable relationship between sales revenue and the nature of technological development, so about the second half of our research hypothesis, we can say that as sales revenue increases, it is more typical for businesses to apply completely new technologies than to develop minor improvements to existing technologies.

So far, we have examined the Slovak and Hungarian companies in the sample together. As a next step, we determine whether there is a significant relationship between the company's location and technological innovation.

Table 8

Distribution of Slovak and Hungarian companies based on the nature of technological development

	Completely new technology	**The major innovation of current technology**	**Minor renovation of current technology**
Slovakia	22%	34%	44%
Hungary	21%	35%	44%

Source: own editing based on primary research.

Table 8 clearly shows that Slovak and Hungarian companies show almost identical results regarding the nature of technological innovations. Two-variable examined also support what is seen in the figure, as the value of the Chi-square is 0.029, and the measured significance level is 0.986. So there is no significant relationship between the site and the implemented technological innovations. After our analysis, we can

state that there is a significant correlation among representatives of the SME sector between the increase in company size and the possibility of introducing new technologies and that the annual sales revenue of the companies also significantly influences the nature of the implemented technological developments. The above findings are equally valid for the markets of the two countries we examined, Slovakia and Hungary. Based on the above, we can state that our hypothesis H1:

H1: A statistically provable difference can discovere between SMEs implementing technological development in the last 5 years based on their different size, sales revenue and the technological nature of the development, we accept it in its entirety.

H2: Factors that encourage the implementation of technological development influences by company size and the company's field of operation.

According to our hypothesis H2, the factors that encourage the implementation of technological development influences by both the size of the company and the area of operation of the company. In the relevant question of our questionnaire, we asked our respondents to use a Likert scale (1-not important at all, 5-completely necessary) to evaluate the factors that motivate them to technological development, such as increasing competitiveness, increasing market share, intention to expand the market, entering a new market increasing the chance of a move. In our analysis, we first examined the distributions between individual incentive factors and the company size of SMEs.

With the increase in company size, our interviewees attributed greater importance to the factors motivating technological development. We indicated an increase in competitiveness as the most crucial motive. Our weighted average was 4.26, followed by increasing market share (3.67), expanding the market (3.60), and entering a new market (3.12) as the least motivating factors. In the case of all four examined factors, however, we can state that the factors encouraging the introduction of technological innovations considermore essential than by our enterprises, regardless of their size. After performing the cross-tabulation analysis, using the Chi-square test at a significance level of 5%, we examined whether we can demonstrate a statistical correlation between between the size of the company and the factors encouraging the introduction of technological innovation. We summarize our research results in the table below.

Table 9

Statistical correlations between factors encouraging technological development and company size

	Chi-square	**Sign.**	**Gamma**	**Somer's d**
Increasing competitiveness	23.688	0.003	0.355	0.227
Increasing market share	22.758	0.004	0.229	0.161
Market expansion	20.268	0.009	0.236	0.165
Entering a new market	42.946	0.000	0.318	0.23

Source: own editing based on primary research.

Based on our chi-square tests, we can state that a significant relationship can discovere between all four factors encouraging technological development and the size of the companies. Considering our previous results, we can conclude that as the size of an SME increases, the company considers technological developments and the motivating factors behind them to be more necessary and vital. After performing the Chi-square tests, since we discovered a significant relationship between all four factors and the company size at a significance level of 5%, we also looked at the Gamma and Somer's d values, which show the closeness of the relationship. The table above also illustrates the results for the individual factors. We can conclude that we can describe a moderately to weakly significant relationship between all four factors stimulating technological development and the size of the companies. About the first half of

our research hypothesis, we can stated that a medium to weaker significant relationship can discovere between company size and the factors that encourage technological development, and as the company size increases, the importance of judging the factors that promote technological development increases.

In the following, we turn to the statistical testing of the second half of our research hypothesis, which is intended to examine the relationship between the operating area of the enterprises and the factors that encourage technological development. Regardless of their field of operation, the investigated companies also indicated increasing competitiveness as the most motivating factor for technological development and entering a new market as the least motivating factor growth. Companies in the processing industry feel the most motivated to pursue technological developments, followed by those in the transportation and storage sectors, as well as the machinery industry. Companies in the tourism and hospitality sector consider introducing technological innovations and the motivation to do so as the least important. After the weighted averages on the Likert scale (1- least important, 5- most important) and the correlation of the companies' operational areas, we examined the individual motivating factors using the statistical Chi-square test and the correlation between the size of the companies at a 5% significance level.

Table 10

The statistical relationship between the importance of the factors encouraging technological development and the operating area of the companies

	Chi-square	**Sign.**	**Cramer V**
Increasing competitiveness	59.537	0.008	0.233
Increasing market share	50.538	0.055	
Market expansion	37.724	0.39	
Entering a new market	62.486	0.004	0.239

Source: own editing based on primary research.

After performing the Chi-square tests, we can state that, among the factors that encourage technological development, a moderate to weaker significant relationship can discovere between the companies' operational area and the increase in competitiveness and the entry into a new market. In contrast, the companies' operational area and the increase in market share and the market expansion, as factors encouraging technological development, there is no significant relationship at a significance level of 0.005.

Based on the combined analyses, we can conclude that the assessment of the importance of the factors that encourage technological development is influenced more by the size of the company and not by the area of operation of the companies. We can, therefore, accept our hypothesis H2 with a slight modification:

Factors encouraging the implementation of technological development influences more by company size and less by the company's field of operation.

5. CONCLUSION

Nowadays, both on a national and international political level, there is an undeniable need to support and develop the innovative capabilities of companies - the positive effects of which we have elaborated in more detail in our literature and references. It can be seen in the economic policy toolkits of various countries, as well as in geopolitical developments, that innovation, technology, and digital developments are key factors for future economic and corporate growth. Various support systems, research grants, local developments, and corporate collaborations contribute to this on a national and international level. The

GDP-proportional share invested in innovation in certain countries is also considered an important question, as it is the foundation of the knowledge-based economy.

It is crucial for small and medium-sized enterprises to look for development opportunities adapted to their real needs, in order to be motivated for their growth, even in different market positions and local conditions. The inevitable adaptation to the change in the era of innovation and digital transformation taking place in the market of businesses is costly and in many cases involves many risks. Small businesses are also a key source of job opportunities for the economy of the countries examined, and they provide a breeding ground for many entrepreneurial ideas. Compared to large transnational companies, they are more closely tied to the region where they operate, contribute to local employment and often take part in improving the local social standard.

In the changed market environment, in addition to regional innovation developments - the primary task of which is to create an appropriate innovative climate for companies and to support the embedding of newly developed innovative, mainly technology-supported enterprises - it is also important to innovate their own technologies of small and medium-sized enterprises.

In the second decade of the 21st century, continuous and dynamic growth has become crucial for companies, which inevitably requires a high level of innovation, technological development, and digitalization. Without these, entering and growing in the market, not only at the European level but even within the narrower V4 region, is impossible. The significance of our research lies, on the one hand, in exploring the technological development opportunities of small and medium-sized enterprises within this context, and on the other hand, in a complex analysis of the interrelationships of factors influencing technological innovations. The added value of our research is the cross-border comparison and the examination of the potential impact of different technological and innovation development potentials in different market environments on small and medium-sized enterprises.

In our analysis, we explored the relationship between technological developments and company size/sales among small and medium-sized enterprises in Hungary and Slovakia. Additionally, we examined how factors stimulating technological developments, such as company size and area of operation, influence this relationship. The uniqueness of our research lies, among other things, in the analysis of companies in neighboring countries and the analysis of potential differences between them. Confirming the results of international studies and investigations, we found that in the case of the examined population, company size influences on the implemented technological developments. Given these insights it is further demonstrated by the fact that, due to the simplicity, flexibility, and lower cost of various technological devices, solutions that were once the privilege of large companies are now accessible to small and medium-sized enterprises. Regarding the technological development of the introduced technology, we constate that, in the case of the companies of the examined sample, as the company size increases, it is more typical for the companies to introduce a completely new technological solution rather than a minor innovation of the existing technology.

Although various state and international sources offer an excellent opportunity to finance technology developments in the first step, any innovation also requires the existence of its own resources. In our analysis, we also investigated the relationship between the nature of technological developments and the sales revenue of companies separately.

Our research results confirmed our assumption that increasing sales encourages investments in new technologies. However, in the case of falling sales, the development/innovation of existing technological solutions is more likely to be experienced in company practice.

Since the companies we examined operate in nearly identical market environments, they have access to similar market solutions at comparable price levels and quality. Local subsidies can considere distinct. Based on the results of your research, we found that the implementation of the developments and the

registered seat/location of the company are not related and do not influence each other among the filling companies.

The competitiveness of small and medium-sized companies is influenced by factors such as the COVID-19 pandemic, conflicts between neighboring countries, unstable economic relations, and various other circumstances. Digitization and the rise of artificial intelligence necessitated the strategic appreciation of the role of technology. In today's rapidly changing market conditions, various technological developments not only enhance competitiveness and market position but are also crucial for many companies. In our analysis, we investigate how the size of the company and its area of operation serve as factors that encourage development. Based on our analysis, we can conclude that the size of the company has a greater impact on the perception of the importance of factors promoting technological development than the company's area of operation. Among the companies included in the sample, the need for technology development is most felt by companies operating in the manufacturing industry, followed by companies operating in fields transportation, storage, and machinery.

6. LIMITATIONS, IMPLICATIONS, AND CONTRIBUTIONS OF THE RESEARCH

Within the framework of this study, it is necessary to mention that during the data collection we faced the problem that the willingness of companies to respond to the online questionnaire was low, which is one of the research limitations that affected our results. In addition, we were unable to collect data from the company side (company name, identification number) that would allow us to specifically identify individual companies and compare their answers with data stored in other databases. Thus, we were not able to check the correctness of the information provided by the companies. As a result, we were able to rely on the answers given by the respondents, and we trusted that they correctly assessed the current situation of their business.

In addition to advancing technological developments for small and medium-sized enterprises, it will be crucial in the future to not only seek innovative technological solutions but also to establish a strategic advisory system for various technologies at local, regional, national, and global levels. In the area of small and medium-sized enterprises and technological changes, particularly regarding development solutions that involve ongoing new challenges, a frequent question is which qualitative or quantitative analysis method would be most suitable for the research methodology. Based on various literary sources and our experiences during the research, we can conclude that fundamental developments and technological innovations have become widespread among small and medium-sized enterprises, particularly regarding basic innovation processes and technological solutions. However, our research highlights some limitations: due to constraints in time and financial resources, we could only address a specific subset of Slovakian SMEs within the examined sector and country. Additionally, the willingness of participants to complete the survey, as well as the time and accuracy they invested in filling out the questionnaire, influenced the results. Since our research employs a benchmarking approach, the collected responses are not representative but rather reflect the practices of the studied population. In the future, it is necessary to examine the impact of developing various production and service factors on the innovation potential of small and medium-sized enterprises, on the one hand, and the potential of new planning and management tools, on the other.

ACKNOWLEDGEMENT

The study is the output of the project VEGA 1/0070/23 - Examining the effects of the uncertain economic environment of small and medium-sized enterprises on new work organization processes.

REFERENCES

Aladin, A., Dewata, E., Sari, Y., & Aryani, Y. A. (2021). The Role of Small and Medium Enterprises (SMEs) and Economic Growth in Indonesia: The VECM Analysis. In *4th Forum in Research, Science, and Technology*, 95-99. Atlantis Press. https://doi.org/10.2991/ahsseh.k.210122.017

Andaregie, A., & Astatkie, T. (2022). Determinants of technology adoption by micro and small enterprises (MSEs) in Awi zone, Northwest Ethiopia. *African Journal of Science, Technology, Innovation and Development*, 14(4), 997-1006. https://doi.org/10.1080/20421338.2021.1923385

Bayo-Moriones, A., Billón, M., & Lera-López, F. (2013). Perceived performance effects of ICT in manufacturing SMEs. *Industrial Management & Data Systems*, 113(1), 117-135. https://doi.org/10.1108/02635571311289700

Bayraktar, M. & Algan, N. (2019). The importance of SMEs on World economies. *International Conference on Eurasian Economies*, 56-61.

Belás, J., Gavurova, B., Cepel, M., Kubak, M. (2020). Evaluation of economic potential of business environment development by comparing sector differences: perspective of SMEs in the Czech Republic and Slovakia. *Oeconomica Copernicana*, 11(1), 139-159. https://doi.org/10.24136/oc.2020.006

Betakova, J., Pietrzak, M. B., & Iglinski, B. (2023). Effect of demographic characteristics of enterprises on the implementation of corporate social responsibility in SMEs context. *Journal of Business Sectors*, 1 (1), 53–62. https://doi.org/10.62222/XQKO8567

Bilan, Y., Oliinyk, O., Mishchuk, H., & Skare, M. (2023). Impact of information and communications technology on the development and use of knowledge. *Technological Forecasting and Social Change*, 191, 122519. https://doi.org/10.1016/j.techfore.2023.122519

Blajer-Golebiewska, A., & Vasa, L. (2024). Effect of reputation and social media on the financial performance of SMEs – a comparison between selected business sectors. *Journal of Business Sectors*, 2 (1), 21–31. https://doi.org/10.62222/ADXS7200

Bruque, S., & Moyano, J. (2007). Organisational determinants of information technology adoption and implementation in SMEs: The case of family and cooperative firms. *Technovation*, 27(5), 241-253. https://doi.org/10.1016/j.technovation.2006.12.003

Chan, C. M., Teoh, S. Y., Yeow, A., & Pan, G. (2019). Agility in responding to disruptive digital innovation: A case study of an SME. *Information Systems Journal*, 29(2), 436-455. https://doi.org/10.1111/isj.12215

Choshin, M., & Ghaffari, A. (2017). An investigation of the impact of effective factors on the success of e-commerce in small and medium-sized companies. *Computers in Human Behavior*, 66, 67-74. https://doi.org/10.1016/j.chb.2016.09.026

Chytilová, E., Talíř, M., Straková, J., & Dobrovič, J. (2024). Impact of digital procurement on economic resilience of enterprises during COVID-19. *Journal of International Studies*, 17(1), 188-204. https://doi.org/10.14254/2071-8330.2024/17-1/11

Das, S., Kundu, A., Bhattacharya, A. (2020). Technology Adaptation and Survival of SMEs: A Longitudinal Study of Developing Countries. *Technology Innovation Management Review*, 10(6), 64-72. http://doi.org/10.22215/timreview/1369

Dibrell, C., Davis, P. S., & Craig, J. (2008). Fueling innovation through information technology in SMEs. *Journal of small business management*, 46(2), 203-218. https://doi.org/10.1111/j.1540-627X.2008.00240.x

Dowling, M., O'Gorman, C., Puncheva, P., Vanwalleghem, D. (2019) Trust and SME attitudes towards equity financing across Europe. *Journal of World Business*, 54(6), 1-16. https://doi.org/10.1016/j.jwb.2019.101003.

Dvorsky, J., Petrakova, Z., Hudakova, M. & Bednarz, J. (2023) National support and legislative change in the business environment of V4 countries: Business sectors view. *Journal of Business Sectors*, 1 (1), pp. 42–52. https://doi.org/10.62222/EQDP3972

European Commission. (2020). User guide to the SME Definition. *Luxemburg: Publications Office of the European Union*, 60. ISBN 978-92-79-69909-2.

Kane, G. C., Palmer, D., Phillips, A. N., Kiron, D., & Buckley, N. (2015). Strategy, not technology, drives digital transformation. *MIT Sloan Management Review*. 14, 1-25.

Khan, K. A., Akhtar, M. A., Vishwakarma, R., K., & Hoang, H. C. (2023). A sectoral perspective on the sustainable growth of SMEs. Empirical research in the V4 countries. *Journal of Business Sectors*, 1 (1), 10–19. https://doi.org/10.62222/CVFW6962

Kleis, L., Chwelos, P., Ramirez, R. V., & Cockburn, I. (2012). Information technology and intangible output: The impact of IT investment on innovation productivity. *Information Systems Research*, 23(1), 42-59. https://doi.org/10.1287/isre.1100.0338

Krammer, S. M., Strange, R., & Lashitew, A. (2018). The export performance of emerging economy firms: The influence of firm capabilities and institutional environments. *International Business Review*, 27(1), 218-230. https://doi.org/10.1016/j.ibusrev.2017.07.003

Kumar, A., & Ayedee, N. (2018). Social media tools for business growth of SMEs. *Journal of Management* (JOM), 5(3), 137-142.

Kumar, M. A., Syed, D. A. A., & Pandey, D. A. (2020). How adoption of online resources can help indian SMEs in improving performance during covid-19 pandemic. *Test Engineering and Management Journal*. 83, 3394-3400.

Luo, P., Wang, H., & Yang, Z. (2016). Investment and financing for SMEs with a partial guarantee and jump risk. *European Journal of Operational Research*, 249(3), 1161-1168. https://doi.org/10.1016/j.ejor.2015.09.032

Matt, C., Hess, T., & Benlian, A. (2015). Digital transformation strategies. *Business & information systems engineering*, 57(5), 339-343. https://doi.org/10.1007/s12599-015-0401-5

Mazzarol, T. (2015). SMEs engagement with e-commerce, e-business and e-marketing. *Small enterprise research*, 22(1), 79-90. https://doi.org/10.1080/13215906.2015.1018400

Mishchuk, H., Samoliuk, N., & Yurchyk, H. (2021). Decent work: evaluation and ensuring in human capital management: monograph: Szczecin: *Centre of Sociological Research*. 140 p. DOI: 10.14254/978-83-959336-5-3/2021 URL: https://csr-pub.eu/?49,en_decent-work-evaluation-and-ensuring-in-human-capital-management

Myslimi, G., & Kaçani, K. (2016). Impact of SMEs in economic growth in Albania. *European Journal of Sustainable Development*, 5(3), 151-151. https://doi.org/10.14207/ejsd.2016.v5n3p151

Nadeem, A., Abedin, B., Cerpa, N., & Chew, E. (2018). Digital transformation & digital business strategy in electronic commerce-the role of organizational capabilities. *Journal of theoretical and applied electronic commerce research,* 13(2), 1-8. https://doi.org/10.4067/S0718-18762018000200101

Ndiaye, N., Razak, L. A., Nagayev, R., & Ng, A. (2018). Demystifying small and medium enterprises'(SMEs) performance in emerging and developing economies. *Borsa Istanbul Review*, 18(4), 269-281. https://doi.org/10.1016/j.bir.2018.04.003

Nekmahmud, M., & Rahman, S. (2018). Measuring the competitiveness factors in telecommunication markets. Competitiveness in Emerging Markets: Market Dynamics in the Age of Disruptive Technologies, 339-372. https://doi.org/10.1007/978-3-319-71722-7_18

Nguyen, K. T., Yeung, T., & Castanier, B. (2017). Acquisition of new technology information for maintenance and replacement policies. International *Journal of Production Research*, 55(8), 2212-2231. https://doi.org/10.1080/00207543.2016.1229069

Nugroho, M. A., Susilo, A. Z., Fajar, M. A., & Rahmawati, D. (2017). Exploratory study of SMEs technology adoption readiness factors. *Procedia Computer Science*, 124, 329-336. https://doi.org/10.1016/j.procs.2017.12.162

Nuseir, M. T., & Aljumah, A. (2020). The role of digital marketing in business performance with the moderating effect of environment factors among SMEs of UAE. *International Journal of Innovation, Creativity and Change*, 11(3), 310-324.

Obi, J., Ibidunni, A. S., Tolulope, A., Olokundun, M. A., Amaihian, A. B., Borishade, T. T., & Fred, P. (2018). Contribution of small and medium enterprises to economic development: Evidence from a transiting economy. *Data in brief*, 18, 835-839. https://doi.org/10.1016/j.dib.2018.03.126

Octavia, A., Indrawijaya, S., Sriayudha, Y., & Hasbullah, H. (2020). Impact on E-commerce adoption on entrepreneurial orientation and market orientation in business performance of SMEs. *Asian Economic and Financial Review*, 10(5), 516. https://doi.org/10.18488/journal.aefr.2020.105.516.525

OECD. (2018). Towards the implementation of the G20 roadmap for digitalisation: Skills, business dynamics and competition.

OECD. (2021). The Digital Transformation of SMEs. 275. ISBN 978-9264367609, https://doi.org/10.1787/20780990

Ollo-López, A., & Aramendía-Muneta, M. E. (2012). ICT impact on competitiveness, innovation and environment. Telematics and Informatics, 29(2), 204-210. https://doi.org/10.1016/j.tele.2011.08.002

Pagani, M., & Pardo, C. (2017). The impact of digital technology on relationships in a business network. *Industrial Marketing Management*, 67, 185-192. https://doi.org/10.1016/j.indmarman.2017.08.009

Pelletier, C., & Cloutier, L. M. (2019). Challenges of digital transformation in SMEs: Exploration of IT-related perceptions in a service ecosystem. 4967-4976. http://hdl.handle.net/10125/59934

Pérez-Gómez, P., Arbelo-Pérez, M., & Arbelo, A. (2018). Profit efficiency and its determinants in small and medium-sized enterprises in Spain. *BRQ Business Research Quarterly*, 21(4), 238-250. https://doi.org/10.1016/j.brq.2018.08.003

Rentková, K., Gejdoš, P. (2019). Small and Medium-Sized Enterprises in the Context of Regional Development in Slovakia. *Proceedings of the International Conference on Economics, Management and Technology in Enterprises 2019 (EMT 2019), Series: Advances in Economics, Business and Management Research*, 78, 30-136, https://doi.org/10.2991/EMT-19.2019.24

Selase, A. M., Selase, A. E., Ayishetu, A., Comfort, A. D., Stanley, A., & Ebenezer, G. (2019). Impact of technology adoption and its utilization on SMEs in Ghana. *International Journal of Small and Medium Enterprises*, 2(2), 1–13. https://doi.org/10.46281/ijsmes.v2i2.382

Sipa, M., Gorzeń-Mitka, I., & Skibiński, A. (2015). Determinants of competitiveness of small enterprises: Polish perspective. *Procedia Economics and Finance*, 27, 445-453. https://doi.org/10.1016/S2212-5671(15)01019-9

Snieška, V., Navickas, V., Havierniková, K., Okręglicka, M., & Gajda, W. (2020). Technical, information and innovation risks of industry 4.0 in small and medium-sized enterprises–case of Slovakia and Poland. *Journal of business economics and management*, 21(5), 1269-1284. https://doi.org/10.3846/jbem.2020.12279

Sugathan, P., Rossmann, A., & Ranjan, K. R. (2018). Toward a conceptualization of perceived complaint handling quality in social media and traditional service channels. *European Journal of Marketing*, 52(5/6), 973-1006. https://doi.org/10.1108/EJM-04-2016-0228

Tarutė, A., & Gatautis, R. (2014). ICT impact on SMEs performance. *Procedia-social and behavioral Sciences*, 110, 1218-1225. https://doi.org/10.1016/j.sbspro.2013.12.968

Tarutė, A., Duobienė, J., Klovienė, L., Vitkauskaitė, E., & Varaniūtė, V. (2018). Identifying factors affecting digital transformation of SMEs. 373-381. https://aisel.aisnet.org/iceb2018/64

Tripathi, S. S., & Brahma, M. (2018). Technology entrepreneurship in emerging markets: An exploration of entrepreneurial models prevalent in India. *Technology Innovation Management Review*, 8(1). 24-32. https://www.timreview.ca/article/1131

Tutar, H., Nam, S., Korpysa, J., & Drotár, I. (2024). Digital innovation in family businesses in the post-pandemic period: A case study. *Journal of International Studies*, 17(2), 100-117. https://doi.org/10.14254/2071-8330.2024/17-2/5

Vravec, J. (2017). Zvyšovanie konkurencieschopnosti slovenských MSP v súčasných ekonomických podmienkach EÚ. *Journal of Global Science*, 2(3), 1-6.

Wilden, R., Gudergan, S. P., Nielsen, B. B., & Lings, I. (2013). Dynamic capabilities and performance: strategy, structure and environment. *Long range planning*, 46(1-2), 72-96. https://doi.org/10.1016/j.lrp.2012.12.001

Yoshino, N., & Taghizadeh-Hesary, F. (2019). Optimal credit guarantee ratio for small and medium-sized enterprises' financing: Evidence from Asia. *Economic Analysis and Policy*, 62, 342-356. https://doi.org/10.1016/j.eap.2018.09.011

Yu, F., & Schweisfurth, T. (2020). Industry 4.0 technology implementation in SMEs–A survey in the Danish-German border region. International *Journal of Innovation Studies*, 4(3), 76-84. https://doi.org/10.1016/j.ijis.2020.05.001

Zide, O., & Jokonya, O. (2022). Factors affecting the adoption of data management as a service (DMaaS) in small and medium enterprises (SMEs). *Procedia Computer Science*, 196, 340-347. https://doi.org/10.1016/j.procs.2021.12.022

Zsigmond, T., & Mura, L. (2023). Emotional intelligence and knowledge sharing as key factors in business management – evidence from Slovak SMEs. *Economics and Sociology,* 16(2), 248-264. https://doi.org/10.14254/2071-789X.2023/16-2/15