


## Innovation activity of Slovak ICT SMEs


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### ABSTRACT

**Research background:** The innovation process is a key factor when creating and maintaining competitiveness, so the SME sector has to address a special attention to it. Examining the impact of corporate co-operation on innovation activity has to be mentioned as a crucial goal.

**Purpose of the article:** The main goal of the research is to assess the innovative activity of the SMEs operating in ICT sector, and to map the distribution between the innovative and non-innovative businesses. The article's purpose was to outline the most recent developments in Slovakia's ICT industry with regard to SME innovation. The empirical study concentrated on the types of innovation, variables that encourage and discourage innovation, and the innovation activity of SMEs in the ICT sector.

**Methods:** In accordance with the main goal of the research, descriptive statistical methods, i.e. unweighted and weighted arithmetic mean were used to analyze the research hypothesis. A questionnaire research study was carried out between September 2021 and February 2022 in Slovak ICT SMEs.

**Findings & Value added:** Significant differences can be determined between the innovative and non-innovative ICT companies in terms of innovation. The majority of SMEs implemented both technological and non-technological innovations. A small number of SMEs failed to implement either type. A significant portion focused on technological innovations, with the majority successfully implementing them, and over half of them introduced non-technological innovations between 2018 and 2020. Over 75% of the companies felt they were more innovative than their competitors. More than 67% of non-innovative SMEs saw themselves as less innovative than their competitors. 92% of innovative SMEs implemented both technological and non-technological innovations. 51% implemented technological innovations. 56.41% innovative SMEs implemented 3 to 5 types of innovation activities, while 38.46% implemented 6 to 7 types. Only 5.13% implemented all 9 types of innovation activities considered. 38% of innovative SMEs spent the most on research and development, 33% allocated highest expenditure to machinery and equipment. In case of supporting SMEs in innovation activities, three market players received above-average ratings: customers and consumers, suppliers of raw materials and piece parts and the group of companies.

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## INTRODUCTION

Globally, small and medium-sized businesses (SMEs) play a critical role in the economies of many nations. Numerous jobs are produced by SMEs. They are crucial for boosting neighbourhood communities and lowering unemployment. SMEs are frequently the starting point for technological advancement and innovation (Belás et al., 2015; Çera et al., 2020; Kozubikova et al., 2015). They can react to market demands more quickly and with greater flexibility. SMEs operate a variety of enterprises and industries, which helps to diversify the economy (Belás et al., 2021). This can lessen reliance on a single industry. They help out local vendors and services, which benefits the neighbourhood. SMEs make the market more competitive, which may result in better products and services for consumers at cheaper costs. It also encourages bigger businesses to enhance their offerings (Rahman et al., 2017). SMEs are frequently where fresh innovators and entrepreneurs begin their careers. They offer a space where fresh concepts and initiatives can be developed. It is typically easier for SMEs to react swiftly to shifts in the market and economy than it is for larger companies.

The focus on SME sector is explained by the fact that this sector forms the backbone of the European and the Slovak economy. It is the main catalyst of innovation. The research is focusing on a relevant issue, since in recent decades both the SME sector and the innovation activity of the SMEs have become the focus of attention (Bartolacci et al., 2020). Nowadays, one of the main tasks of SMEs is to strengthen their innovation activity. As a result of constant market pressure, SMEs are forced to remain innovative (Metzker et al., 2021). Successful innovation activity has a positive impact on competitiveness; the assessed knowledge will improve the chance for competitiveness, enhance the economic efficiency and performance (Hu & Chen, 2023). This is why researchers found important to examine this sector in terms of innovation.

Examining the innovative activity of Slovak SMEs in the information and communication technology (ICT) industry is the major goal of the study. The study aims to pinpoint SME innovation's top focus areas. Investigating and identifying elements supporting and impeding innovation as well as anticipated trends in innovation is another goal. A comparison of the innovation practices of micro, small, and medium-sized businesses will also come from the research.

The study emphasizes on a relevant and current topic because, in Slovakia, professional public interest has recently focused on the SME sector and the innovative initiatives of SMEs. As Slovakia's SME innovation rate trails far below the EU average, one of the primary challenges facing SMEs today is stepping up their innovation efforts. The study's findings may serve as motivation for SMEs in Slovakia as well as for those in charge of economic policy. Because the authors' own data is used, the research is unique.

The structure of the paper is as follows. The first section looks at the core theoretical ideas in the field of innovation. The following section contains a detailed statement of the research's goal, methodology, and data sources. After a brief discussion, the results of the empirical inquiry are provided. The conclusions of the study are described at the end.

## THEORETICAL BACKGROUND

Innovation in general is the process of creating and introducing new ideas, concepts, products, technologies, services or processes in order to achieve improvement or innovation in some aspect of life, business or society. Innovation can be applied in a variety of fields and takes different forms. Innovation is always something new, whether it is a new product, a new process, a new technology, a new market approach or a new way of solving a problem. The aim of innovation is to improve existing states of affairs or to provide solutions to new problems. It may be to improve efficiency, quality, competitiveness or customer satisfaction. Innovation often carries with it a certain amount of risk and uncertainty, as new ideas may not always succeed in the marketplace. However, successful innovations can bring significant rewards. Innovation is often the result of creative thinking and systematic research. They may require the gathering of new knowledge and the use of creative problem-solving techniques. Innovation is not just about ideas, but also about successfully introducing them into the market or into existing processes. This implementation can be technically challenging and require the collaboration of multiple people or organisations. Successful innovations can have a long-term positive impact on society, the economy and people's lives. They can change the way businesses operate and the way people live (Aristovnik et al., 2023; Cope, 2011; García Manjón et al., 2016).

Innovation is essential for the growth and development of societies and economies and is the driving force behind creating new jobs, increasing competitiveness, improving living standards, and solving various societal and environmental problems (Rauter et al., 2019). Innovation can be present in all sectors, from scientific research to business and cultural spheres (Boons et al., 2013). Innovation in the economy represents new ideas, concepts, technologies, products, services, and ways to apply them in business that contribute to growth, efficiency, and improvement of the economic environment. These innovations can take different forms and manifestations in an economic context. For example, process innovation refers to the improvement of existing production, business or service processes. They reduce costs, increase efficiency and enable faster production (Asswad et al., 2016). Technological innovations involve the development of new technologies or the application of existing technologies to new purposes. These innovations often change industry norms and can create new industries. The current mood in society calls for green and environmental innovations that seek to improve the environmental sustainability of production and consumption. These

include energy efficiency, renewable energy, and green solutions (Cao et al., 2022).

According to Rašner (2009), the innovation process of companies is the development of an innovative idea (invention), which during the further steps of the process (innovation opportunities, innovation) has to transform into competitive advantage of the product.

Innovation is a process of activities that result in development of a new product and positive change in the company structure. The process is not a random activity, but guided by a specific project or program. The aim is to purposefully influence the production activity of the company in accordance with satisfying the increasing needs and requirements of the customers. The innovation process involves 5 steps: science, research, development, production and utilization. The process does not have to pass through all the mentioned steps, if it is not about a significant innovative change. Partial innovative changes or smaller changes in quality improvement are described as a process restricted to phases, which are necessary to ensure a certain type of innovation (Öberg, 2019).

Schumpeter interpreted the economic development as a historical process of structural change lead by innovation. He divided the innovation process into 3 phases: invention, innovation and diffusion. The same 3 basic phases of the innovation process, each of which can be divided into further phases, containing further activities. They add that the detailed breakdown provides a complex, comprehensive picture, and this type of interpretation is implemented in the case of major innovation changes. In the case of partial innovation changes, the process is often limited to activities and phases, which are necessary to ensure particular innovation. The first phase is the phase of invention, which is about the development of new and creative ideas. It can be supposed that the frequency of inventions is determined by the scientific knowledge. The invention itself is not an innovation, it is a simple idea. The second phase of the innovation activity is the innovation process itself. It is a scientific, R&D, empirical and organizational activity aimed at starting and maintaining the innovation process. In this stage, the new ideas or inventions are transformed into marketable products or production processes. The product becomes useable in a particular industry with the help of innovation. This forms the first phase of commercial use of the invention. Its development is determined by technological and economic conditions in which the company operates in. Following the successful innovation, the technological change is following a determined technological path. Diffusion is the third phase of the innovation process. It is the spread of innovation, in which the new products or production processes, which have already been approved and applied, will be implemented and become widespread in new places (Rašner, 2009).

During the innovation process, the number of ideas and thoughts are decreasing, but this is one of the basic principles of the process. It is about the acceleration of an invention-innovation chain in the company, which starts

with innovation incentives and continues with innovative ideas, intentions and proposals, and finally culminates in innovative program of the company. The innovation process is expensive and involves the substantial part of the company's utilizable sources. The company has to gain back the invested effort and resources, if the company has chance for survival in a competitive environment. A sad fact is that 35% of the innovations or the product itself is not finished when launched or the new product launched on the market will not succeed. The reason of bad results is usually due to wrong decisions made in the first phase of the innovation process. According to Damanpour (2017, online), product innovations are driven by consumer needs and demand. He stated that innovation is „the satisfaction of consumer needs on a higher level”.

Innovation plays a key role in the growth and success of small and medium-sized enterprises (SMEs) in all sectors. SMEs are often considered as innovation engines of the economy because they are flexible, adapt quickly to new trends and have the potential to revolutionize existing markets (Battistella et al., 2023). SMEs need to have clearly defined innovation strategies. This means determining what kind of innovation they want to achieve and what resources they will need to achieve it (Aliasghar & Haar, 2023). An innovation culture in SMEs is crucial. Businesses should encourage creativity among their employees, create an environment where ideas can flourish, and reward innovation (Espasandín-Bustelo et al., 2021; Rozsa et al., 2021). In the case of Dias et al. (2021) research, SMEs should follow market trends and customer needs. Knowing the needs of their customers enables SMEs to develop products and services that will have real value. Innovation often requires financial investment. SMEs can use different sources of funding such as grants, venture capital, loans or internal resources. Innovation is an integral part of SMEs and can be a driving force for growth, profitability and sustainability. SMEs that can adapt to a rapidly changing environment and invest in innovative solutions have a distinct advantage in the marketplace (Dvorsky et al., 2020; Metzker et al., 2021; Rocha, 2012).

Information and Communication Technologies (ICT) are an integral part of the modern world and play a key role in all sectors of the economy. At their core is the processing, storage, transmission and exchange of information using computers and communication devices (García Manjón et al., 2016).

The essence of information and communication technologies (ICT) lies in their ability to process, store, transmit and communicate information. This includes data analytics, word processing, image and audio technologies, electronic data storage, cloud storage, databases and various levels of backup, fast and reliable remote communication including the Internet, mobile networks and email, process automation and systems management including robotics and artificial intelligence, and data protection and cybersecurity to ensure the integrity and se-

curity of digital information (Al-Jabri & Al-Busaidi, 2020; Hu & Chen, 2023).

The importance of ICT lies in its ability to increase the efficiency and productivity of businesses, support the globalization of communication and commerce, stimulate innovation in various sectors, and improve the quality of life of individuals in healthcare, education, and transportation (Keček et al., 2022; van der Velden, 2018).

The ICT business encompasses various aspects including software and hardware development, provision of IT services such as network management and cloud solutions, e-commerce and digital marketing, video game and multimedia application development, and cybersecurity. This field is dynamic and competitive, but offers many opportunities for value creation and innovation in the modern economic environment (García Manjón et al., 2016).

Innovation in the information and communication technology (ICT) segment is constantly pioneering and driving technological advances. These innovations are bringing many changes to the field that are impacting the way we communicate, work, and live. For example, the development of 5G technology represents a guarantee of faster and more reliable mobile connectivity, opening the door for new applications, including augmented reality (AR) and the Internet of Things (IoT). Further, artificial intelligence (AI) and machine learning have made tremendous strides in ICT, improving data analytics, process automation, and personalization of services. These technologies are used in a wide range of sectors including healthcare, finance and industry (Al-Jabri & Al-Busaidi, 2020; Marzi et al., 2023).

In the field of quantum computing, a new way of computing is emerging that offers incredible computational power, with the potential to impact the solution of complex problems such as cryptography and scientific research. Augmented Reality (AR) and Virtual Reality (VR) are enhancing human interactions with the digital world, found in gaming, education and design (Battistella et al., 2023).

The Internet of Things (IoT) allows physical devices and objects to be connected to the Internet, enabling their monitoring and control in real time. IoT finds applications in areas such as smart homes, Industry 4.0 and urban infrastructure management. With the increasing number of cyber threats, more sophisticated cybersecurity technologies and practices are being developed to protect data and networks (Battistella et al., 2023).

Last but not least, blockchain technology, distributed and immutable, is finding applications in financial services, healthcare, supply chain, and many other industries. Quantum computers open up a new way of computing with incredible computational power and the potential to impact the solution of complex problems such as cryptography and scientific research. Innovations in this area of ICT are continuously changing the way we communicate,

work and use technology, with broad implications for society and everyday life (Battistella et al., 2023).

The previous research data (Statistical Office of SR, 2018) confirmed that 75,7% of the innovative companies operating in industry or service sector implemented technological innovation (product, process). We supposed that most of the domestic SMEs focus on innovation of products/services. Based on the theoretical foundations and the scientific literature used, incremental innovation is the most dominant form of innovation (Acenoglu et al., 2022). It is also worth paying attention to differential (incremental) innovation with a special focus on incremental product/service, since the Japanese management achieved significant success through continuous improvements.

## RESEARCH OBJECTIVE, METHODOLOGY AND DATA

The aim of the study is to present significant trends in innovation in the SME segment in the context of ICT firms in Slovakia. The study is based on descriptive research since one of its main objectives is to evaluate the creative activity of domestic SMEs and to look at that of SMEs working in the ICT sector. To support this objective, a questionnaire research was conducted between September 2021 and February 2022. A non-metric scale (nominal scale) was used for hypothesis testing, which is the simplest and least informative scale and instead of numbers, it classifies qualities e.g. innovation activity (innovative/non-innovative). Data from the Finstat.sk website was used in this process. 1,000 SMEs operating in the ITC sector out of a total of 8,416 eligible firms were randomly contacted as part of the research. The ITC sector is quite specific and the total number of companies operating in it is relatively small compared to the total number of SMEs in Slovakia. For these reasons only 12.4% of the surveyed companies from the ICT sector participated actively in filling in the questionnaire. Data obtained through questionnaire survey was treated anonymously. Researchers examined the types of innovation in the period of 2018-2020, the responses provided for the level of innovation in the case of different innovation types, as well as the responses to motivating factors in case of generating innovation. To test hypothesis, descriptive statistical methods i.e., unweighted and weighted arithmetic mean were used.

The formulation of hypothesis is partly based on the information obtained from scientific literature and the research and reports from Statistical Office of Slovak republic (2018) with main emphasis on innovation activities of domestic SMEs. Based on the method of expert estimation, the following hypotheses were defined:

- H1: SMEs in the ICT segment focus on service innovation, marketing innovation and product innovation. The share of these firms is more than 25%.
- H2: Technological innovation is implemented by ICT firms to a greater extent than non-technological innovation.

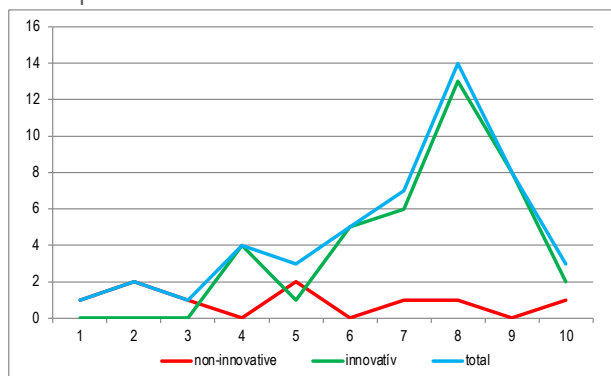
- H3: More than 50% of all ICT firms have implemented 5 or more types of innovation.
- H4: Science and research costs represent the highest cost burden for ICT firms.
- H5: Customers of ICT firms are the most important cooperation partner in innovation.

Descriptive statistics and graphical display methods were used to test the scientific hypotheses.

## RESULTS AND DISCUSSION

A total of 124 questionnaires were evaluated. In terms of corporate ownership, the overwhelming majority are domestic SMEs operating in the ICT sector. The majority of the respondents were owners, 69% of the respondents were managers and 17% worked as employees. The results related to innovation activities are as follows: most of the respondents (82%) prefer the development of service innovation, but 67% of the respondents consider the development of product innovation to be important, while 56% found introduction of new production process or technology an important type of innovation. As an important type of innovation were mentioned the marketing innovation or development of new organizational solutions.

Figure 1 Self-assessment of innovation activity compared to competitors.



Source: Own processing based on the results of the questionnaire survey

The respondents were asked (on scale from 1 to 10) to evaluate their innovation activity compared to their competitors. Calculating a weighted average, the companies rated their own innovativeness in comparison to their competitors at an average of 6,92 points. More than 75% companies (77,08%) rated their innovation performance better than the performance of their competitors on the market. 22,92 % of the businesses think that their innovation performance lacks behind the competitors. Only 6,25% SMEs considered their innovative activity to be particularly bad and 10,4% consider themselves to be quite bad. While in case of non-innovative SMEs, the average value of self-assessment in previous years was 4,78. While more than 67% of non-innovative SMEs consider themselves less innovative than its competitors only 13% of innovative SMEs think the same about themselves. If is examined the same question vice versa, 87% of the innovative SMEs assess their innovative activity with more than 5 points in terms of their competitors, while 33% of non-innovative SMEs gave higher than 5 points. The Figure 1 illustrates the self-assessment of innovation activity of all SMEs (innovative and non-innovative SMEs).

### H1 was confirmed.

Researchers also examined the ratio of technological and non-technological innovations, but the team no longer took into account the ratio of those answering „no“ (see in Table 1). The research was conducted by taking into account the responses provided for different types of innovation implemented by innovative SMEs. The number of technological innovations (product, service, process) for each respondent was determined without repetition of the implementation phases for certain type of innovation (e.g. the implementation was successful both in the case of product and process innovation, however the response provided by the respondent was counted once as a technological innovation). We applied the same method in the case of examining the non-technological innovations (organizational, marketing innovation and the rest of innovation types). In this case, the total number of innovative SMEs was the basis to calculate the distribution of each type of innovation. It was assumed that all the examined innovative SMEs implemented technological innovation in the period between 2018 and

Table 1 – The occurrence of technological and non-technological innovations in the period 2018-2020 among the SMEs operating in ICT sector

	Implementation phases of innovation			total SME	innovative SMEs
	successful	in progress	unfinished		
technological innovation (product, service, process)	72 %	51 %	10 %	81 %	100 %
non-technological innovation (organizational, marketing and all other types of innovation)	54 %	59 %	10 %	75 %	92 %

Source: Own processing based on the results of the questionnaire survey

2020. 92% realized also non-technological innovations. If it is considered the implementation phase of innovations, it can be detected an equal ratio of innovative SMEs, where the implementation of both technological and non-technological innovation initiatives failed (10%). SMEs implementing technological innovations (51%) have an advantage of 8% over those SMEs implementing non-technological innovations (59%), where implementation of innovation was still in progress in the examined period. Most of the innovative SMEs that successfully implemented innovations during the examined period (72%) had implemented technological innovations, while more than half of them (54%) produced non-technological innovations between 2018 and 2020.

## H2 was confirmed.

If is considered the implementation level of the innovation activity, it could be seen that in the case of each type of innovation, a small or zero percentage of unfinished or failed innovation activity occurred. For many innovative SMEs, the improvement and further development of the existing products and services were successful (54%). Further 51% of SMEs launched successful product innovation, and equal proportion of them (49%) implemented service and process innovation successfully. 36% of the innovative SMEs implemented organizational innovation, while 31% were successful in marketing innovation. In the case of each type of innovation, an ongoing innovation activity could be detected, the implementation was in progress during the examined period, thus during the examined period the implementation was not finished. 38% of the SMEs realized service innovation during the examined period, less than 1/3 prepared marketing innovation, while equal 28% of them prepared organizational and product innovation.

If researchers examined the complexity of innovation activities, seen in Table 2, it could be said that more than half of the innovative SMEs (56,41%) implemented minimum 3 and maximum 5 types of innovation activities; a bit more than 1/3 (38,46%) implemented minimum 6 and maximum 7 types of innovation activities; and only 5,13% of these companies implemented 9 types of innovation activities in the period between 2018 and 2020. The table

below presents the innovation activities implemented during the examined 3-years period from the perspective of innovative and the rest of the SMEs involved in the research. Since scholars recognized the new products, new services, improved products/services, process innovation, establishment of new organization, organizational innovation, creating new markets, marketing innovation and the new purchasing sources as different types of innovation, was calculated with a total of 9 types of innovation activities.

If was taken into account the complexity of the innovation activity in terms of 5 main types of innovation (product innovation, service innovation, process innovation, organizational innovation and marketing innovation), it can be said that the innovative SMEs conducted a complex innovation activity during the examined period. The majority, more than 1/3 of the respondents (36%) conducted 3 types of innovation activities in the past period, 31% carried out 4 types of innovation activities, while 26% dealt with 5 types of innovation activities. There was not a single SME that implemented only 1 type of innovation activity during the examined period.

## H3 was confirmed.

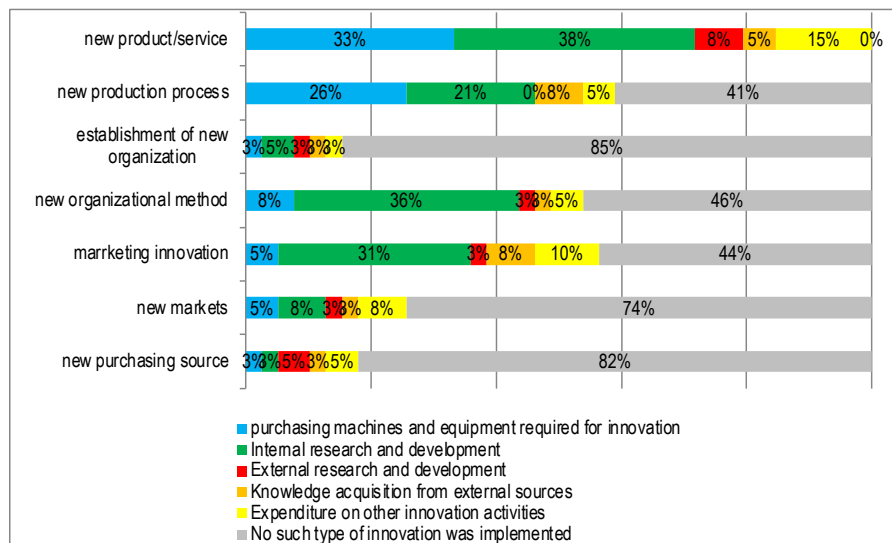
The following questions addressed the expenses required for innovation activities. It was assessed the type of the highest expenditure spent on innovation activity among the innovative companies. The respondents could mark only a single component for each type of innovation, which, according to them represented the highest amount of expenditure of the given type of innovation in the research period (2018-2020). Based on the results obtained, in the case of product and service innovation, the largest expenditure for 38% of innovative SMEs was in the field of research and development (R&D). Further 33% of the business considered the purchase of machinery and equipment necessary to implement innovation as the highest expenditure. In the case of process innovation, the majority of innovative SMEs (26%) reported that the highest expenditure was spent on purchasing machinery and equipment, while 21% of the businesses spent the most of their expenditure on R&D. In the case

Table 2 – Complexity of the innovation activity

	successful (S)	in progress (IP)	unfinished (U)	Total (S, IP, U)	all SMEs	innovative SMEs
none	0,00 %	0,00 %	0,00 %	0,00 %	18,75 %	0,00 %
1 type	15,38 %	46,15 %	38,46 %	100,00 %	0,00 %	0,00 %
2 types	43,75 %	50,00 %	6,25 %	100,00 %	0,00 %	0,00 %
3 types	41,67 %	58,33 %	0,00 %	100,00 %	12,50 %	15,38 %
4 types	64,29 %	28,57 %	7,14 %	100,00 %	14,58 %	17,95 %
5 types	75,00 %	25,00 %	0,00 %	100,00 %	18,75 %	23,08 %
6 types	0,00 %	100,00 %	0,00 %	100,00 %	16,67 %	20,51 %
7 types	50,00 %	50,00 %	0,00 %	100,00 %	14,58 %	17,95 %
8 types	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %	0,00 %
9 types	100,00 %	0,00 %	0,00 %	100,00 %	4,17 %	5,13 %

Source: Own processing based on the results of the questionnaire research

Figure 2 – Type of the highest amount of expenditure spent on given type of innovation activity



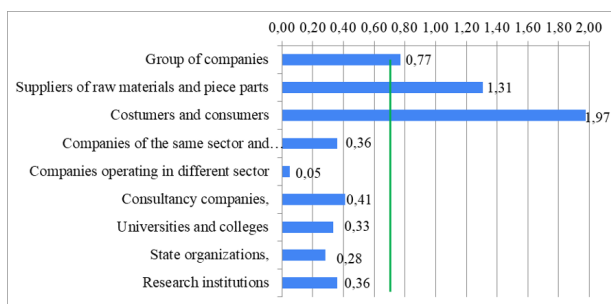
Source: Own processing based on the results of the questionnaire survey

of organizational and marketing innovation, the highest expenditure (36 % and 31 %) was also spent on R&D.

In case of the expenditure type spent on innovation activities based on the assessment of responses provided by the respondents, it can be assumed that most of the SMEs involved in innovation activity spent the highest amount of expenditure on internal research and development (43%). They are followed by the SMEs, which show high expenditure costs on purchasing machines and equipment supporting innovation. The smallest group is formed by those SMEs, which spent the most financial sources on external research and development in order to implement innovation.

#### H4 was confirmed.

Figure 3 – Assessment of co-operation with market players and institutions



Source: Own processing based on the results of the questionnaire survey (average = 0,65)

#### H5 was confirmed.

Researchers investigated to what extent the mentioned market and institutional actors helped the innovative

SMEs in implementing their innovative activities. The innovative SMEs could evaluate the help received by each actor on a scale from 1 to 4. Calculating a weighted average, 3 market players received an above-average rating – customers and consumers (1,97 points), suppliers of raw materials and piece parts (1,31 points) and the group of companies (0,77 points). The mentioned actors also helped the innovation activities of the businesses. The customers and consumers helped 42% of the SMEs entirely co-operating with them (4), and helped further 38% of SMEs adequately (3) to implement their innovations. The co-operation with suppliers helped 44% of the SMEs, as well as helped the innovation activity of 31% of businesses adequately. The co-operation with the group of businesses helped 50% of the SMEs in implementing their innovation activities.

On average, companies rated their innovativeness at 6.92 points. Over 75% of the companies felt they were more innovative than their competitors, with 22.92% believing they lagged behind. In the case of non-innovative small and medium-sized enterprises (SMEs), their average self-assessment score in previous years was 4.78. More than 67% of non-innovative SMEs saw themselves as less innovative than their competitors, while only 13% of innovative SMEs felt the same way about themselves.

Out of the innovative SMEs examined, 92% implemented both technological and non-technological innovations. When considering the implementation phases, an equal number of SMEs (10%) had failed to implement both types. Among the SMEs, 51% implemented technological innovations, while 59% implemented non-technological innovations, with a majority (72%) successfully implementing technological innovations and over half (54%) producing non-technological innovations between 2018 and 2020. In this context, innovation, not only within the ICT sector services provided, is an important factor of

economic growth and competitiveness (Dubyna et al., 2022).

More than half of the innovative SMEs (56.41%) implemented 3 to 5 types of innovation activities, while about 1/3 (38.46%) implemented 6 to 7 types. Only 5.13% implemented all 9 types of innovation activities considered. When focusing on 5 main types of innovation (product, service, process, organizational, and marketing), it's noted that innovative SMEs engaged in complex innovation activities. Specifically, 36% conducted 3 types, 31% conducted 4 types, and 26% conducted 5 types. No SME implemented only one type of innovation activity during this period. It is necessary for SMEs to fully realise that scientific and technological innovation is a source of survival and development of enterprises, but also the key to realising their prosperity (Belas et al., 2021).

For product and service innovation, 38% of innovative SMEs spent the most on research and development (R&D), while 33% allocated their highest expenditure to machinery and equipment. For process innovation, 26% spent the most on machinery and equipment, and 21% on R&D. In the case of organizational and marketing innovation, the highest expenditure (36% and 31%) was also on R&D. Overall, most SMEs involved in innovation activities spent the most on internal research and development (43%), followed by those investing in machinery and equipment. A smaller group allocated their financial resources to external research and development for innovation implementation.

In case of supporting SMEs in innovation activities, three market players received above-average ratings: customers and consumers (1.97 points), suppliers of raw materials and piece parts (1.31 points), and the group of companies (0.77 points). Customers and consumers significantly aided 42% of SMEs (rated as 4), and 38% of SMEs received adequate assistance (rated as 3) from them to implement their innovations. Cooperation with suppliers benefited 44% of SMEs and was adequate for 31% of businesses. The group of businesses cooperated with and helped 50% of the SMEs in implementing their innovation activities. These results can be partially supported by Taçoğlu et al. (2019) – they recommended to focus on long-term relationships with the customers because this approach enables them to provide high quality products and services to customers and gain their loyalty (Taçoğlu et al., 2019).

## CONCLUSION

The article's objective is to outline the most recent developments in Slovakia's SME innovation in the ICT industry. The empirical study concentrated on the types of innovation, variables that encourage and discourage innovation, and the innovation activity of SMEs in the ICT sector. On average, companies rated their innovativeness positively. Most companies considered themselves

more innovative than their competitors, but a smaller portion believed they were less innovative. Non-innovative SMEs, on average, rated themselves as less innovative compared to their competitors, while a minority of innovative SMEs had similar self-perceptions.

The majority of SMEs implemented both technological and non-technological innovations. A small number of SMEs failed to implement either type. A significant portion focused on technological innovations, with the majority successfully implementing them, and over half of them introduced non-technological innovations between 2018 and 2020.

The majority of innovative SMEs engaged in a range of innovation activities. More than half of them implemented between 3 to 5 types, while around a third tackled 6 to 7 types. Only a small percentage managed all 9 types of innovation activities considered. Focusing on the primary innovation categories, it's evident that innovative SMEs were involved in complex innovation endeavors. A significant portion worked on multiple types simultaneously, with no SME concentrating solely on a single type of innovation.

For product and service innovation, a notable share invested primarily in research and development (R&D), while machinery and equipment were the key expenses for others. Process innovation saw a significant portion allocating their highest expenditure to machinery and equipment, and a smaller group prioritized R&D.

Regarding support for SMEs in their innovation efforts, three key market players received above-average ratings: customers and consumers, suppliers of raw materials and piece parts, and the group of companies. Customers and consumers played a significant role in aiding SMEs. Similarly, cooperation with suppliers benefited a significant proportion of SMEs.

The research presented here also certainly has limitations and constraints. The research was carried out in one SME sector in Slovakia on a limited sample of respondents. At the same time, only descriptive statistics methods were used to evaluate the hypotheses. Research conducted in only one country is difficult to generalize. Despite these limitations, the authors are convinced that the research will contribute to broadening the horizons of ICT firms' entrepreneurship and innovation activities.

Future activities of the author's team are aimed at extending the research to other countries and comparing the presented data from Slovakia with other countries. At the same time to enrich the research with other specific areas of investigation and the use of more sophisticated statistical methods.

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