

Examining the innovation activity of Hungarian small and medium-sized enterprises in the construction industry

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Abstract: The innovation behavior of small and medium-sized enterprises (SMEs) is raising more and more questions, not only regarding their performance and competitive position but also affecting their economic perception. It is well known that SMEs are key players in the economy, which also holds true for the Hungarian economy. This research focused on examining the factors influencing the innovation activities of SMEs operating in the Hungarian construction industry. The empirical research was conducted using a questionnaire survey. A total of N=169 construction companies were surveyed. The validity of the hypothesis formulated in the research was tested using parametric ANOVA analysis. The main finding of the study is that significant differences can be identified in innovation activity based on company size among SMEs operating in the construction industry. The most intense innovation gap exists between medium-sized enterprises and micro and small enterprises, influenced by the innovation behavior of competitors, the demand for new management innovations from industry associations, the lack of technological preparedness within the company, and the innovation willingness of the management. For SMEs in the construction industry, staying up to date and allocating more resources to developing their innovation behavior is crucial for their operation and market presence. Within the industry, the key to success lies not only in surpassing competitors and convincing management but also in prioritizing technological innovations.

Keywords: Innovation activity, building industry, SME, Hungary.

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Introduction

Small and medium-sized enterprises (SMEs) are key players in the global economy. Due to their size, they operate flexibly, adapt more quickly to constantly changing markets, and contribute to expanding employment opportunities. To maintain their economic stability, they must keep pace with the evolving market environment. This type of stability and even competitive advantage can be achieved through innovation, which brings improvements to the products or services offered by SMEs and alters internal processes and management practices. Innovations require significant financial and human resources. Financial support may come from EU or national funding, various projects, and grants, while human capital is primarily ensured by skilled and committed employees. The concept of encouraging innovation activity applies similarly to SMEs operating in the construction industry. The construction sector holds a special position compared to other industries, as it not only performs independent activities but also supports numerous other sectors. The primary aim of innovations in construction is the implementation of modern technological solutions at the enterprise level, although sustainable and environmentally friendly methods are also gaining increasing attention.

The aim of the research was to examine the innovation activity of SMEs in the Hungarian construction industry. The study identified factors influencing innovation activity among SMEs and analyzed differences in their relevance. Based on the research aim, the following hypothesis was formulated:

- H1: There is a significant difference in the factors influencing innovation activity among construction companies, depending on company size.

Literature Review

Innovation ensures development, economic growth, access to new markets, and competitive advantage for companies. A corporate culture that inhibits innovation or is not sufficiently open to new business solutions risks its own survival. Innovation should be among the strategic goals of a company. For the SME sector, it is especially important to secure market position through innovation, utilize existing resources, and possibly acquire new ones or gain competitive advantages. At the corporate level, innovation is usually incremental aimed at stabilizing and improving existing capacities, capabilities, and practices while radical innovation often involves developing entirely new concepts, which SMEs generally struggle to achieve. Promoting SME innovation activity is the responsibility of policymakers at the EU, national, regional, and local levels (Bujáki & Vinogradov, 2024; Carrasco-Carvajal et al., 2023). Open innovation can take the form of a new or significantly altered product or service, a new practice, or even a marketing or organizational method that impacts business operations, job reorganization, or networking (Ramdani et al., 2023; Vale et al., 2021). An innovation-driven organizational culture is characterized by openness to change and novelty, the ability to manage risk, and a constant drive for action. The innovation capacity of SMEs is affected by employee knowledge

and competencies, which are essential for implementing innovative practices. Access to financial resources is a long-standing challenge for SMEs; therefore, EU funds and bank loans play a fundamental role in the practical implementation of innovative solutions. Building networks and forming valuable partnerships with universities, research institutes, and other organizations enable the flow of knowledge, technology, and information, stabilizing innovation efforts (Janasz et al., 2022). Furthermore, managerial attitude significantly influences the management, implementation, and internal acceptance of innovation (Avelar et al., 2024). Collaboration-based innovation activity requires companies to share some internal information with partners, while also ensuring the protection of their strategic advantages. The solution lies in creating an effective organizational culture that enables smooth innovation processes within the company (Agustina & Argata, 2023). Technological innovation significantly alters the internal processes and the economic activities of SMEs (Pickernell et al., 2013). SMEs' innovation advantage over large enterprises is mostly linked to managerial practices they are less formal, have lower bureaucratic burdens, and due to their size, motivation is easier to achieve. Fundamental technological innovations are often easier and quicker to adapt within SMEs compared to larger enterprises (Korcsmáros et al., 2024). According to Lewandowska (2021), SMEs are increasingly focused on promoting innovation activities. She noted that innovation activity is influenced by company size, industry sector, and investment expenditures. Company size affects labor standards, employment levels, and partly market expansion. She highlighted several industries with specific challenges, including construction, where operational and labor costs require special attention. In terms of investment, expenditure on machinery, equipment, intellectual property, and training varies across firms. The success of innovation is supported by many factors, including internal company conditions, economic justification, customer demand, and the feasibility and potential of new ideas. Through innovative efforts, companies gain advantages such as increased market potential, job creation, technological advancement, contributions to structural change, export opportunities, expanded R&D collaboration, financial stability at regional and local levels, and the development of stable networks (Janasz et al., 2024). The EU aims to create an integrated innovation market that offers optimal conditions for promoting innovation activities, especially for SMEs, which make up 99% of all EU enterprises. To support innovation, several national-level support programs have been established (Kravchenko, 2019). Balogh and Varga (2025) emphasized that SMEs in the tourism value chain also face resource shortages, which can be addressed through government support, skilled management, and a clear strategic vision. Once these conditions are met, innovation can be successfully implemented based on sustainability principles. Based on research in Indonesian SMEs, Abdullah et al. (2024) found that leadership approach, networking, and digital marketing innovation positively impact innovation efficiency. Ćirović et al. (2025), examining Montenegrin SMEs, concluded that due to international pressure, SMEs sometimes adopt innovations outdated in the broader market, representing novelty only to the companies themselves. A common mistake is imitating leading firms' technologies locally. The lack of innovation development often stems from the weaknesses of the R&D sector, hindering the spread of knowledge-driven practices. Karácsóny et al. (2025) identified the main factors influencing the innovation activity of Hungarian SMEs,

particularly emphasizing financial conditions, company size and age, and the importance of knowledge transfer. Their research found that most Hungarian SMEs value innovation, but the main barriers are a lack of financial support and high costs. Company size and age are less relevant to innovation activity than the internal flow of knowledge and information. In another Hungarian study focusing on logistics, Karácsóny et al. (2025) found that innovation efficiency in SMEs is based on internal and external knowledge management methods. Valkó and colleagues (2025) concluded that Hungarian SMEs evaluate their innovation activity to varying degrees, even though just over half define themselves as innovation-driven companies. Research by Kovács and Nemeslaki (2024) revealed that innovation-driven firms in Hungary gain significant advantages in terms of venture capital and financial resources, affecting both their innovation capacity and market success. These firms typically exhibit effective resource use, positively influencing their production and development processes. Organizational culture and motivation are also crucial for adapting to innovation and enhancing innovation capacity.

The construction industry is a critical sector upon which other industries depend. Value creation largely depends on expanding and modernizing existing assets and services. Continuous technological advancement has brought significant changes to construction practices and workflows. Based on this perspective, the term Construction 4.0 was coined by R. Berger in 2016, recognizing the growing need for technological adaptation in the sector. Advanced digital technologies include building information modeling (BIM), data environments, drones, cloud-based project management, and artificial intelligence (Singaram et al., 2023). In Hungary, the construction industry plays a vital role and, prior to the COVID-19 pandemic, was rapidly developing thanks to EU and national funding. However, a strong consolidation was observed in 2021. For decades, the Hungarian construction sector has been dominated by SMEs, with over 90% of construction firms employing fewer than five people (Boros & Kovács, 2022). Thorpe and Ryan (2007), in their study of the Australian residential construction industry, emphasized that meeting market requirements and customer expectations compels companies to offer innovative and sustainable solutions aiming to maintain industry leadership and avoid competitive displacement. According to Kuklina et al. (2020), significant competition exists among firms in the construction industry. The growing number and specialization of firms are driving down construction and installation costs while increasing quality achieved through various innovative solutions. Innovations in construction enable the implementation of automated information systems at all project stages and rely on new, energy-efficient technologies. Construction innovations can be categorized based on the specific challenges they address. Today, the most important trends in modern construction include technological advancements and environmentally friendly materials.

Methodology

The empirical research was conducted using a quantitative research method. A questionnaire-based survey was used to examine the factors influencing the innovation activities of companies, as well as the extent to which these factors differ based on company size. The survey was conducted anonymously, and the respondents representing the companies participated voluntarily. The applied sampling method was purposive sampling, which falls

under the category of probability sampling. The target group consisted of small and medium-sized enterprises (SMEs) operating in the construction industry. Data collection took place in 2024. During the questionnaire survey, $N = 169$ construction companies were successfully surveyed. The questionnaires were distributed electronically. The questionnaire included scale-type questions, in which respondents evaluated statements related to the companies' innovation activities using a 7-point Likert scale (ranging from 1 to 7). As a first step, the innovation-related statements were analyzed using descriptive statistical methods. This was followed by an ANOVA analysis to statistically test Hypothesis H1, as formulated in the introduction. The ANOVA method is suitable for identifying

differences between variables and is particularly appropriate for testing Hypothesis H1. The data obtained from the research and the statistical analysis of Hypothesis H1 were performed using the SPSS statistical software.

Results and Discussions

Figure 1 illustrates the percentage distribution of the companies participating in the study according to their size. Among the surveyed companies, 41.4% were micro-enterprises (<10 employees), 39.6% were small enterprises (<50 employees), and 18.9% were medium-sized enterprises (<250 employees).

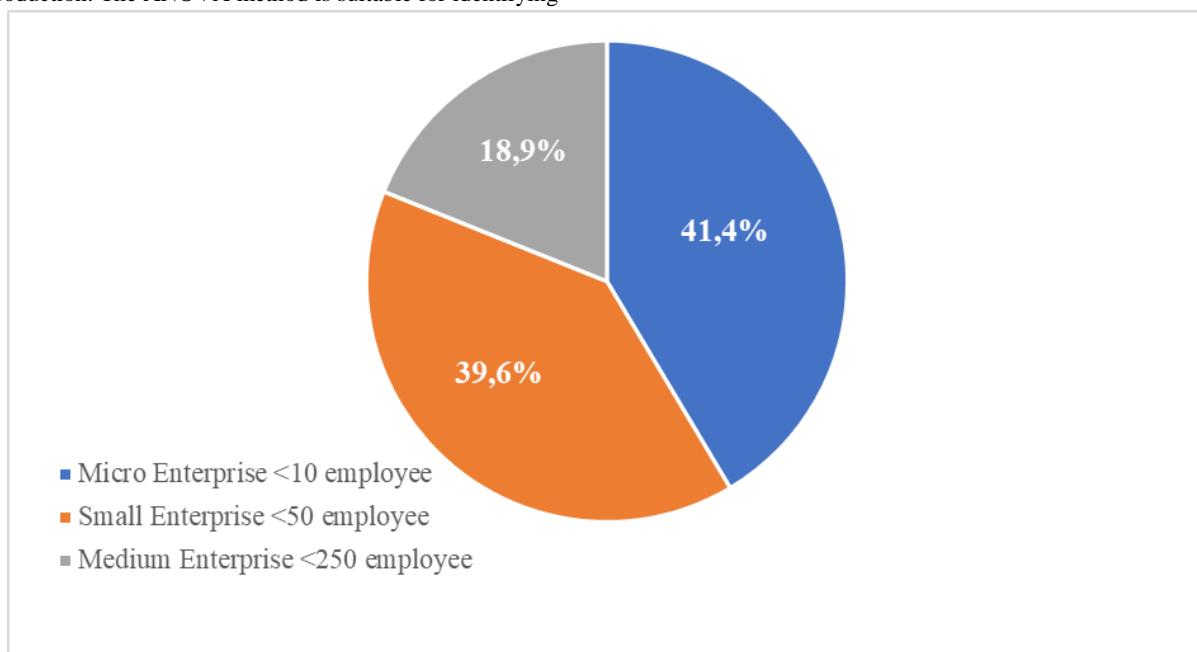


Fig.1. Enterprises by size

Source: Own research

Table 1. presents the factors influencing the innovation activities of companies using basic descriptive statistics. Among the SMEs participating in the study, 24.9% reported that innovations introduced by competitors (F1: $Md.=5$; $Mn.=4.00$) had a strong influence on their own innovation activities. Recognition by suppliers and customers within the industry moderately

influenced 23.7% of SMEs (F2: $Md.=4$; $Mn.=4.00$). The demand from customers for new products or services moderately influenced innovation efforts in 27.8% of cases (F3: $Md.=4$; $Mn.=4.00$), while industry associations' demand for new managerial innovations influenced 26.6% (F4: $Md.=3$; $Mn.=4.00$). Meanwhile, demand from the state or local government for new managerial innovations had a below-moderate impact on 19.5% of the SMEs (F5: $Md.=3$; $Mn.=3.00$).

Table 1: Descriptive Statistics regarding factors exerting pressure on the enterprises' innovation activity

	F1	F2	F3	F4	F5	F6	F7	F8	F9
N	169	169	169	169	169	169	169	169	169
Missing	0	0	0	0	0	0	0	0	0
Mean	4,14	3,59	3,83	3,55	3,43	4,00	4,04	3,64	3,59
Mode (Md.)	5	4	4	3	3	3	4	4	3
Median (Mn.)	4,00	4,00	4,00	4,00	3,00	4,00	4,00	4,00	3,00
Std. Deviation	1,571	1,568	1,504	1,558	1,792	1,884	1,789	1,556	1,788

Variance	2,468	2,458	2,262	2,428	3,210	3,548	3,201	2,423	3,195
Frequency	42	40	47	45	33	35	34	43	35
Percent (%)	24,9	23,7	27,8	26,6	19,5	20,7	20,1	25,4	20,7

Factors:

F1: New innovation introduced by competitors
F2: Better recognition of other enterprises in the industry by suppliers and consumers
F3: Customer demand for a new product or service
F4: Industry association demand for new management innovation
F5: State or local government demand for new management innovation
F6: Lack of state or local government support
F7: Lack of workforce competence
F8: Lack of technological readiness of the enterprise
F9: Lack of management willingness

Source: Own research

Table 2. presents the results of Levene's test for homogeneity of variances. Based on the outcome of the homogeneity test, $p > 0.05$, which indicates non-significance,

meaning that the assumption of equal variances is met, and thus the ANOVA analysis can be performed.

Table 2: Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
	1,008	2	166	,367
F1	1,075	2	166	,344
F2	,448	2	166	,639
F3	,814	2	166	,445
F4	2,375	2	166	,096
F5	,765	2	166	,467
F6	5,127	2	166	,007
F7	1,568	2	166	,211
F8	3,000	2	166	,053
F9	1,008	2	166	,367

Source: Own research

Table 3. presents the results of the ANOVA analysis regarding the factors influencing the innovation activities of SMEs. Significant differences can be identified among the influencing factors based on company size. These differences are evident at a significance level of $p = 0.024 < 0.05$, most notably in the following areas: innovations introduced by competitors (F1), $p =$

$0.014 < 0.05$; demand for new managerial innovations from industry associations (F4), $p = 0.000 < 0.05$; lack of technological preparedness (F8), $p = 0.001 < 0.05$; and lack of managerial willingness (F9). Based on these factors, it is necessary to conduct a post hoc test to gain a more detailed understanding of the differences.

Table 3: ANOVA Statistics

		Sum of Squares	df	Mean Square	F	Sig.
F1	Between Groups	18,126	2	9,063	3,795	,024
	Within Groups	396,465	166	2,388		
	Total	414,592	168			
F2	Between Groups	10,269	2	5,135	2,116	,124
	Within Groups	402,736	166	2,426		
	Total	413,006	168			
F3	Between Groups	3,159	2	1,580	,696	,500
	Within Groups	376,864	166	2,270		
	Total	380,024	168			
	Between	20,326	2	10,163	4,354	,014

F4	Groups					
	Within Groups	387,497	166	2,334		
	Total	407,822	168			
F5	Between Groups	9,760	2	4,880	1,530	,220
	Within Groups	529,566	166	3,190		
	Total	539,325	168			
F6	Between Groups	10,909	2	5,454	1,547	,216
	Within Groups	585,091	166	3,525		
	Total	596,000	168			
F7	Between Groups	18,584	2	9,292	2,971	,054
	Within Groups	519,203	166	3,128		
	Total	537,787	168			
F8	Between Groups	39,650	2	19,825	8,959	,000
	Within Groups	367,332	166	2,213		
	Total	406,982	168			
F9	Between Groups	45,205	2	22,602	7,632	,001
	Within Groups	491,624	166	2,962		
	Total	536,828	168			

Source: Own research

Table 4. presents, using the Bonferroni test, the differences in the factors influencing the innovation activities of SMEs by company size. The impact of innovations introduced by competitors (F1) shows a significant difference between medium-sized and small enterprises ($p = 0.020 < 0.05$). The demand for new managerial innovations from industry associations (F4) displays a significant difference between medium-sized and micro-enterprises ($p = 0.011 < 0.05$). There is intense competition among SMEs operating in the construction industry, which is also confirmed by the statistical analysis. The innovation activities of competitors influence the innovation activity of other construction firms, as emphasized by Thorpe and Ryan (2007) and Kuklina et al. (2020). The lack of technological preparedness (F8) shows significant differences between medium-sized and small enterprises ($p = 0.002 < 0.05$) as well as between medium-sized and micro-enterprises ($p = 0.000 < 0.05$). The construction industry is increasingly adopting modern, technology-driven solutions, which not only provide a competitive advantage but also lead to greater customer satisfaction. However, significant differences can

be observed among companies regarding technological innovations. The importance of technological innovation and its role as a source of competitive advantage is highlighted in the research of Singaram et al. (2023) and Pickernell et al. (2013). Korcsmáros et al. (2024) argue that SMEs are often more suitable for implementing technological innovations than large corporations. In terms of lack of managerial willingness (F9), significant differences are observed between medium-sized and micro-enterprises ($p = 0.001 < 0.05$) and medium-sized and small enterprises ($p = 0.003 < 0.05$). The innovation activity of SMEs in the construction sector greatly depends on the attitude of their management, as discussed by Abdullah et al. (2024) and Avelar et al. (2024). SMEs with management that is open to innovation are more adaptable to change and can therefore gain a competitive advantage. In summary, it can be concluded that even within construction SMEs, there are significant differences that influence their innovation activities. Based on the statistical analysis, the validity of hypothesis H1 has been confirmed.

Table 4: Multiple Comparisons (Bonferroni Test)

Dependent Variable	(I) Size	(J) Size	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
F1	Medium Enterprise	Small Enterprise	,914*	,332	,020	,11	1,72
F4	Medium Enterprise	Micro Enterprise	,962*	,326	,011	,17	1,75
	Medium Enterprise	Small Enterprise	1,118*	,320	,002	,34	1,89

F8	Medium Enterprise	Micro Enterprise	1,311*	,317	,000	,54	2,08
F9	Medium Enterprise	Micro Enterprise	1,371*	,367	,001	,48	2,26
	Medium Enterprise	Small Enterprise	1,253*	,370	,003	,36	2,15

*. The mean difference is significant at the 0.05 level.

Source: Own research

Conclusion and Recommendations

Small and medium-sized enterprises (SMEs) play a significant economic role at global, national, regional, and local levels, which is also true for the Hungarian economy. Numerous domestic and international studies have addressed the innovation activities of SMEs; however, a research gap still exists regarding sector-specific investigations. This gap served as the motivation for the present research, which focused on examining the innovation activities of SMEs operating in the Hungarian construction industry. The importance of innovation among SMEs in the construction sector is becoming increasingly emphasized not only for maintaining competitive advantage but also for achieving customer satisfaction. The construction industry holds a unique position, as it does not only function as an independent sector but also supports a wide range of other industries through its economic activities. The research revealed that even within the construction industry, significant differences exist in the innovation activities and levels of engagement among SMEs. The main factors determining the innovation activities of construction SMEs identified in this study include: the innovation gap between competitors, the demand for new managerial innovation from industry associations, the level of technological preparedness, and the lack of willingness toward innovation on the part of company management. Although policymakers, as well as theoretical and practical experts, are actively involved in supporting SMEs and enhancing their innovation performance, I consider it necessary to continue similar research in the future with a focus on different sectors. Innovation can manifest in various forms and at different levels, potentially displaying diverse approaches and degrees of willingness depending on the industrial context. In addition to examining the innovation behavior of SMEs across sectors, it would also be justified to assess the innovation activities of large enterprises and multinational corporations within a sectoral framework. Drawing parallels between the similarities or, conversely, highlighting the most significant differences could provide valuable insights.

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