


Examining the perceived and actual digital readiness of micro and small enterprises in Hungary

Adam Pentek

University of Debrecen, Faculty of Economics and Business, Institute of Methodology and Business Digitalisation Debrecen, Hungary
pentek.adam@econ.unideb.hu

 0000-0003-1236-5130

Sandor Kovacs

University of Debrecen, Faculty of Economics and Business, Coordination and Research Centre for Social Sciences, Debrecen, Hungary

kovacs.sandor@econ.unideb.hu

 0000-0002-1216-346X

Tamas Kovacs

University of Debrecen, Faculty of Economics and Business, Institute of Methodology and Business Digitalisation Debrecen, Hungary
kovacs.tamas@econ.unideb.hu

 0000-0001-5437-5009



ABSTRACT

Research background: This paper examines the changing role of information and communication technology (ICT) and mobile applications in today's business world in terms of perceived and actual digitalisation. Digital transformation is a central issue in modern business strategies, yet there is often a mismatch between what companies believe about their digital maturity and what their actual practices reflect. Understanding this discrepancy is essential for developing effective digital strategies.

Purpose of the article: The aim of the study is to investigate the differences between perceived and actual digitalisation in Hungarian companies, focusing on how business leaders evaluate their digital capabilities and how these perceptions align with measurable indicators. The research also aims to identify discrepancies that could hinder strategic digital development.

Methods: A quantitative research approach is taken by using a questionnaire survey to collect data from business leaders in Hungary. The data collected are subjected to statistical analysis, including the Kolmogorov-Smirnov test to establish normality and scale reliability assessment using McDonald's omega. Finally, mixed data factor analysis (FAMD) is used to comprehensively analyse the companies and explore patterns across different company sizes.

Findings & Value added: The results show significant differences between companies of different sizes in the scoring of each of the digitalisation factors. Larger companies consistently give higher scores to these factors, indicating a perceived higher level of digitalisation. However, when comparing perceived and actual levels of digitalisation, an opposite trend emerges. The study shows a significant gap between the two perceptions, especially in areas such as customer management and service. These findings underscore the importance of accurately measuring digitalisation and the need for targeted strategies to bridge the gap between perceived and actual digital capabilities. The added value of this study lies in highlighting the risk of overestimating digital maturity and providing insights into the digital strategy development process for businesses.

RECEIVED: May 5  **ACCEPTED:** July 15  **PUBLISHED ONLINE:** December 31

KEYWORDS: digitalisation, SMEs, application, ICT, digital maturity

JEL CLASSIFICATION: L10, O12, O31

CITATION: Pentek, A., Kovacs, S. & Kovacs, T. (2025). Examining the perceived and actual digital readiness of micro and small enterprises in Hungary. *Journal of Business Sectors*, 3(2), 1–9. <https://doi.org/10.62222/DOYU2932>

INTRODUCTION

The authors state the aim of the research topic and its focus in general, explain its originality, and introduce its structure.

According to the Hungarian Central Statistical Office (HCSO) (2023), the micro and small enterprise sector has a significant presence in Hungary, both in terms of the number of firms and the number of employees. As

noted in several publications (Sándor & Gubán, 2021; Masenya, 2023), the size of the firm is a crucial factor in determining the adoption of digital technology. It is worth noting that new ICT tools and processes are typically first introduced in the multinational sector. Research studies have confirmed that some small and medium-sized enterprises (SMEs) may face challenges in fully exploiting digital opportunities due to various factors such as the lack of a national framework for successful adoption,

corporate culture, business mindset, technical know-how, and limited financial resources (Fan & Ouppara, 2022). It is important for businesses to continuously adapt in a rapidly digitising environment in order to remain competitive (Csordás et al., 2022). Importantly, falling behind in terms of IT resources can have significant disadvantages, as their performance, effectiveness, and adaptability are critical areas that need to be improved. In addition, both local and large-scale problems can negatively affect the economic potential of MSMEs, as noted by (Sunday Chinedu Eze et al., 2021).

Information and Communication Technologies (ICT) have become increasingly important in all sectors. Having a solid IT background, sufficient technological knowledge, and ensuring the consistent use of these tools is crucial for effective operation. Sándor and Gubán (2021) found that Hungarian microenterprises have a lower level of digital readiness compared to even modestly sized small and medium-sized enterprises. In contrast, it is worth noting that small and medium-sized enterprises (SMEs) play a dominant and important role in the national economy.

The study presented the results of a questionnaire survey in which enterprises assessed their ICT readiness. The survey aimed to identify perceived and identifiable stress points in their business processes, and to map the digital maturity of local businesses, including their use of ICT and the IT skills needed and available for their business. Fig. 1 illustrates the research methods and processes.

Figure 1: Research methods and processes



Source: Authors' own construction

THEORETICAL BACKGROUND

The early 21st century has witnessed rapid digitalisation, significantly influencing various domains of life, particularly the economy. Researchers have long been interested in the impact of ICT tools on various aspects of life. The emergence of mobile technology has been another significant step forward, freeing businesses from location constraints and adding new dimensions to many aspects of life. Several studies have examined how mobile applications are used in business operations and what impact they have on efficiency, customer engagement, and decision-making (Hardiyanto et al., 2022; Iakovets et al., 2023). Iakovets et al. (2023) found that the use of apps increased employee motivation. Adiwijaya et al. (2022) suggested that small and medium-sized enterprises (SMEs) could benefit from adopting mobile applications and regularly updating them with new innovative methods. In addition, various researchers have examined

the impact of ICT tools, especially mobile-based programs, on business operations (Darmoyo, 2024; Fernández-Portillo et al., 2020; Zhang et al., 2022). Several studies have highlighted that many small and medium-sized enterprises (SMEs) use information technology to improve their performance (Csordás & Füzesi, 2019). However, some studies suggested that the performance of SMEs in this area is still low (Omimakinde & Dickson, 2022; European Commission, 2022). Therefore, it seemed beneficial to investigate the situation in Hungary and identify any trends. It is important to consider how to influence this situation while recognizing the complexity of the issue and the need for cooperation between stakeholders. According to EU surveys conducted in 2018 and 2020, Hungary is falling further behind at the European level (Bánhidi et al., 2020; European Commission, 2022; Singh et al., 2024). The aim of this research was to address the question of how individuals who have a significant impact on the operation of SMEs perceive them.

Challenges facing MSMEs and their level of digital maturity

The constantly changing market environment poses challenges for small and medium-sized enterprises (SMEs) in the European Union and Hungary (Bánhidi et al., 2020; Bánhidi et al., 2023). These challenges include the persistent lack of resources and difficulties in accessing external funding, which the European Union and Hungary have attempted to alleviate for years. SMEs play a crucial role in the economies of both Europe and Hungary. In order to promote economic growth, it is important to support the development of entrepreneurship. Both micro-enterprises and SMEs play a crucial role in a country's economic growth. While domestic SMEs may face certain challenges compared to their Western counterparts, the latest ICT technologies can be a valuable tool to address competitiveness issues. ICT-based business management can also be beneficial for business continuity in times of pandemic by facilitating the exchange of information inside and outside the company. According to the European Commission's Digital Economy and Society Index 2020 (DESI), Hungary is ranked 23rd out of 28 EU countries (Bánhidi et al., 2020). It is worth noting that the score has improved since 2015, in line with the EU average. It is also worth noting that the adoption of new technologies among Hungarian MSMEs remains relatively low, with only 10–20% of SMEs (according on the DESI index) incorporating them into their processes (European Commission, 2022). Hungary ranked 26th out of 28 EU countries in 2020 in terms of business digitalisation and e-commerce performance, placing it among the lowest performers in the region (European Commission, 2022). Moreover, the gap between Hungary and the EU average in this area was widening rather than narrowing (European Commission, 2022). Improving digital readiness is also a concern in other developed countries (Csordás and Füzesi, 2019). In some instances, the government employs affiliated organisations to achieve this goal (Lassnig et al., 2021).

Kergroach (2020) stated that digital technology can potentially reduce costs, save time, and speed up business processes. This statement is especially relevant for companies that produce low-volume products. Several authors argue that one of the most important advantages of digital systems for MSMEs is their ability to reduce barriers to internationalisation. (Csordás & Füzesi, 2019; Fernández-Portillo et al., 2020; Jou et al., 2024). Although SMEs often focus on domestic markets, digitalisation plays a key role in enhancing their ability to access international markets more efficiently. The greater the degree of digitization of a company's functions, the more advantageous its prospects of competing beyond its domestic market. It is important to recognize that this entrepreneurial approach performs more effectively in foreign markets. Integrating Customer Relationship Management (CRM), Enterprise Resource Planning (ERP), and other valuable systems is crucial for enhancing digital maturity and can also facilitate the successful internationalization. This expanded market could provide SMEs with greater opportunities for growth and success. Adapting to and addressing this need is essential for businesses of this size, where lacking capital and labour is a common problem (Gunta and Andra, 2020). Management maturity has an impact on competitiveness. Evidence suggests that capability studies for larger companies are not appropriate for SMEs (Ortiz de Guinea and Raymond, 2020; Hong & Park, 2014).

The European Commission has been making significant efforts to facilitate and promote the digitization of businesses, aiming to strengthen their competitiveness in the digital era (Švarc et al., 2020). The European Commission proposes the following actions to promote the digitalisation of enterprises in Europe, with clear European added value (Johnson & Turner, 2015, European Commission, 2020):

- Shared investment in digital innovation
- Supporting the development of digital innovation hubs, with a particular focus on private-academic relations
- Encouraging public-private partnerships in the value chain
- Appropriate regulatory framework
- Human capital for digital transformation (dialogue with social partners, new digital skills).

According to recent research conducted by Masenya (2023) and Sándor & Gubán (2021), SMEs may overestimate their digital readiness. This may be due to a limited understanding of digitalisation, with some people only associating it with a website or a basic online presence. Observations indicate that some SMEs are not fully aware of the digital tools and technologies available to them, nor do they understand how these tools could affect their business operations. While some SMEs may use specific digital tools or technologies in certain areas of their business, they may not have fully integrated them across all functions. It is worth noting that resistance to change is a

common barrier to digitalisation, especially among SMEs that have established processes and routines. Although SMEs may acknowledge the potential advantages of digitalisation, they often exhibit reluctance to allocate time, resources, and effort towards adopting new technologies, primarily due to concerns regarding potential disruptions or the perceived complexity of implementation. Limited resources and expertise can be significant barriers for SMEs. As SMEs are often characterized by a lack of capital, they may lack the financial resources to invest in technology upgrades or the in-house expertise needed to effectively adopt and utilize digital tools.

This article examines how SMEs' management and employees perceive the benefits of digitalisation and their perspectives on the transition. According to several studies (Adiwijaya et al., 2022; Brávác & Krebsz, 2021; Hardiyanto et al., 2022; Sommer, 2015), SMEs perceive themselves to be fully or almost fully up to date with digitalisation. However, it is important to consider whether this perception matches reality. Previous literature suggested that digital systems and solutions have the potential to facilitate the operations of SMEs. However, it remains uncertain whether SMEs are effectively using these solutions. In light of this information, we formulated the following hypotheses:

- H1: The actual level of digitalisation corresponds to the perceived level
- H2: Larger companies perceive digitalisation differently

RESEARCH OBJECTIVE, METHODOLOGY AND DATA

Before completing the research questionnaire, we conducted three semi-structured interviews with well-established businesses in Hajdú-Bihar County (HBC) that were highly respected in their field. The aim of the research was to identify not only the focal points of SMEs' digital maturity through literature, but also the benefits, support, risks, and barriers to achieving the vision. The conclusions drawn from the interviews were used as the basis for the closed questionnaire. The researchers conducted this survey to verify the hypotheses formulated based on the defined objectives. We carried out the questionnaire survey in the fall of 2021 and early 2022 with 300 respondents, and 180 enterprises completed it. The data was collected from micro and medium enterprises operating in HBC. Data collection involved personal visits to each respondent and was paper-based. The sample appeared to be representative of the sectoral distribution within the population.

In this study, the authors used both descriptive statistics to summarize the data and multivariate analysis techniques to explore complex relationships between variables. In order to compare the distribution of the sectors in the population and the sample, the Kolmogorov-Smirnov test was used. Means, standard deviations and 95% confidence intervals were calculated for the studied factors and variables in the research. The reliability and internal

consistency of the scales were assessed using McDonald's omega (McDonald, 2013) as an alternative to Cronbach's alpha. This was because the assumptions underlying Cronbach's alpha (equal factor loadings and uncorrelated errors) are highly restrictive and frequently violated (Hayes & Coutts, 2020). In order to create size groups using sales revenue and the number of employees and managers, five clustering methods were tested, using the Silhouette index (Rousseeuw, 1987) as the internal measure of clustering quality. Authors strived to use the most commonly applied techniques like Hierarchical Cluster Analysis (HCA) with Ward's method (Ward, 1963), Kmeans clustering with MacQueen's (Macqueen, 1967) and Forgy methods, distribution-based clustering and Partition Around Medoids (PAM) (Kaufman & Rousseeuw, 1990). After defining the size groups, the authors used a Kruskal-Wallis test to examine differences in actual and perceived digitalisation between the groups. The Kruskal-Wallis analysis also identified the relationship between process overload types and departments. Finally, the authors used the Factor Analysis of Mixed Data (FAMD) technique (Pagès & Pagès, 2014) to create a map representing the companies together with both continuous (sales revenue, total number of employees and managers) and categorical data (overload type). This map highlighted and summarized all the relationships in the data. All calculations were performed with R 4.2.3. (2023-03-15) (R Core Team, 2023), all figures were created using R Studio 2022.02.2 (Build 485) and further enhanced with Inkscape 1.0.1. vector image editor. In order to draw the dual Y-axis image and the stacked bar graph, readr, dplyr, tidyr, ggplot2 and patchwork packages were used. The authors used the EMCluster package for distribution-based clustering, the stats package for K-means and hierarchical clustering, the cluster package for PAM clustering and to calculate the Silhouette index, and the FactoMineR package to perform FAMD.

RESULTS & DISCUSSION

Table 1 presents the descriptive statistics for the main background factors of the population and the sample. Next, the distribution of the overload types and their differences by department were examined. The mean and the standard deviation of the investigated items of the actual and perceived digitalisation scales were also presented (Tab. 1). Finally, the results were presented with an evaluation of the clustering and the FAMD analysis. The actual and perceived levels of digitalisation were also presented separately for the firm sizes generated in the clustering procedure.

Table 1: Descriptives of the main background factors

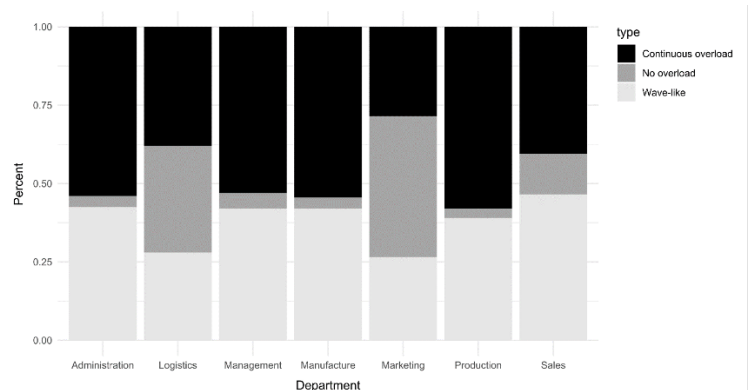
Sector	Population (count and %)	Sample (count and %)
Agriculture	465322 (26)	52 (26)
Processing	77472 (4)	14 (7)
Construction	140374 (8)	20 (10)

Trade and Car service	182545 (10)	25 (13)
Transportation	49778 (3)	7 (4)
Hospitality	73791 (4)	5 (3)
Information and communication	69877 (4)	6 (3)
Finance and Insurance	29938 (2)	1 (1)
Real estate	231655 (13)	17 (9)
Science and engineering	213647 (12)	28 (14)
Administration	79141 (4)	10 (5)
Education	59528 (3)	7 (4)
Human health services and social work activities	44643 (2)	4 (2)
Other services	77632 (4)	4 (2)
Size-related factors	Mean (min, max)	95% Confidence Interval
S1 Total number of employees (person)	8.1 (1;99)	(6.4 - 9.8)
S2 Total number of managers (person)	1.6 (1;6)	(1.4 - 1.8)
S3 Sales revenue of the company (million HUF)	226.1 (1;3,439)	(161.1 - 291.1)

Source: Authors' own calculation

The Kolmogorov-Smirnov test was used to evaluate the equality of the two distributions with respect to sector. The test showed that the population and sample distributions were identical with no significant difference (D=0.143; p=0.983), indicating that the sample is representative.

Figure 2: Distribution of overload types across departments



Source: Authors' own calculation

Manufacturing, administration, and management all showed a similar pattern of overload, with approximately 50% of processes experiencing continuous overload (Fig. 2). Marketing processes were less likely to be continuously overloaded, with only about 29% experiencing it. Continuous overload was also relatively low in logistics (38%). The highest overload level was observed in production, while sales had the highest percentage of wave-like overloads.

Table 2: Basic statistical description and reliability of the studied variables in the questionnaire

Perceived digitalisation (PD)	Mean	Standard deviation	McDonald's ω if item dropped
1: not prepared at all; 5: very well prepared			
PD1 Evaluation of consumer expectations	2.16	1.24	0.835
PD2 Usage of marketing tools	1.90	1.34	0.857
PD3 Management of potential customers	3.10	1.22	0.812
PD4 Order management	3.12	1.25	0.814
PD5 Customer support service	3.08	1.21	0.814
PD6 Business communication with partners	4.06	0.85	0.845
PD7 Human resource management	1.48	1.07	0.864
Actual digitalisation (AD)	Mean	Standard deviation	McDonald's ω if item dropped
AD1 Verification of business processes /1: frequently revised; 5: no need for a revision/	2.27	1.49	0.767
AD2 Restructure business processes with a consultant /1: should be restructured; 5: no need for a restructure/	3.43	1.11	0.517
AD3 Number of non-automatic processes /1: 10 <; 2: 5-10; 3: 2-5; 4: only 1; 5: 0/	2.47	0.84	0.573

Source: own calculation

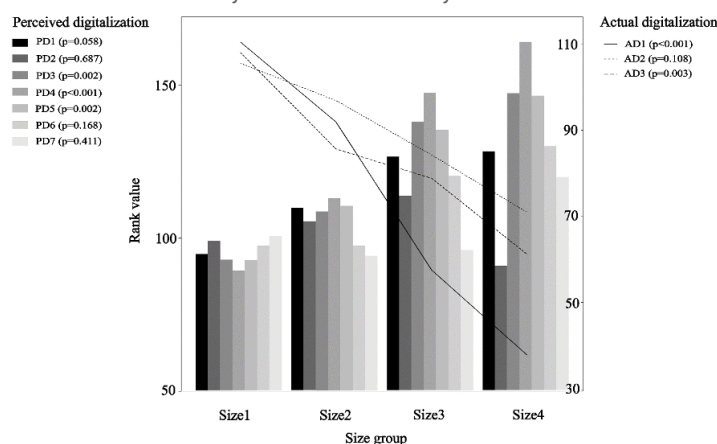
It can be observed that higher values are associated with better levels of both actual and perceived digitalisation. It is worth noting that perceived digitalisation was highest for PD6 and lowest for PD1, PD2, and PD7. These three questions formed a distinct cluster compared to PD3-

PD6 and required separate investigation. Actual digitalisation scores were relatively higher for AD2 and the lowest for AD1. The results of the study confirmed the reliability of the perceived digitalisation scale ($\omega = 0.855$) and the actual digitalisation scale ($\omega = 0.736$) (Table 2). For perceived digitalisation, removing an item did not significantly increase the omega coefficient. In contrast, removing the first item from the actual digitalisation scale would result in a slight increase in the omega coefficient, reaching 0.767. However, the authors decided to retain this item, as the scale should comprise at least three items.

The study focused primarily on size, which was determined using the main size-related factors listed in Table 3 and analysed through cluster analysis. Table 3 presents the results of the validation process.

The authors applied five cluster analysis methods to create four clusters. The Silhouette index was used to select the best clustering. The authors used hierarchical clustering with the Ward method for the subsequent analyses, as this produced the highest average Silhouette index (Table 3). Table 3 shows the average sales revenue and number of employees, as well as their 95% confidence intervals, within each cluster. Finally, the authors produced four well-separated clusters according to firm size using hierarchical clustering with the Ward method.

Figure 3: Rank values of perceived and actual digitalisation by Kruskal-Wallis analysis



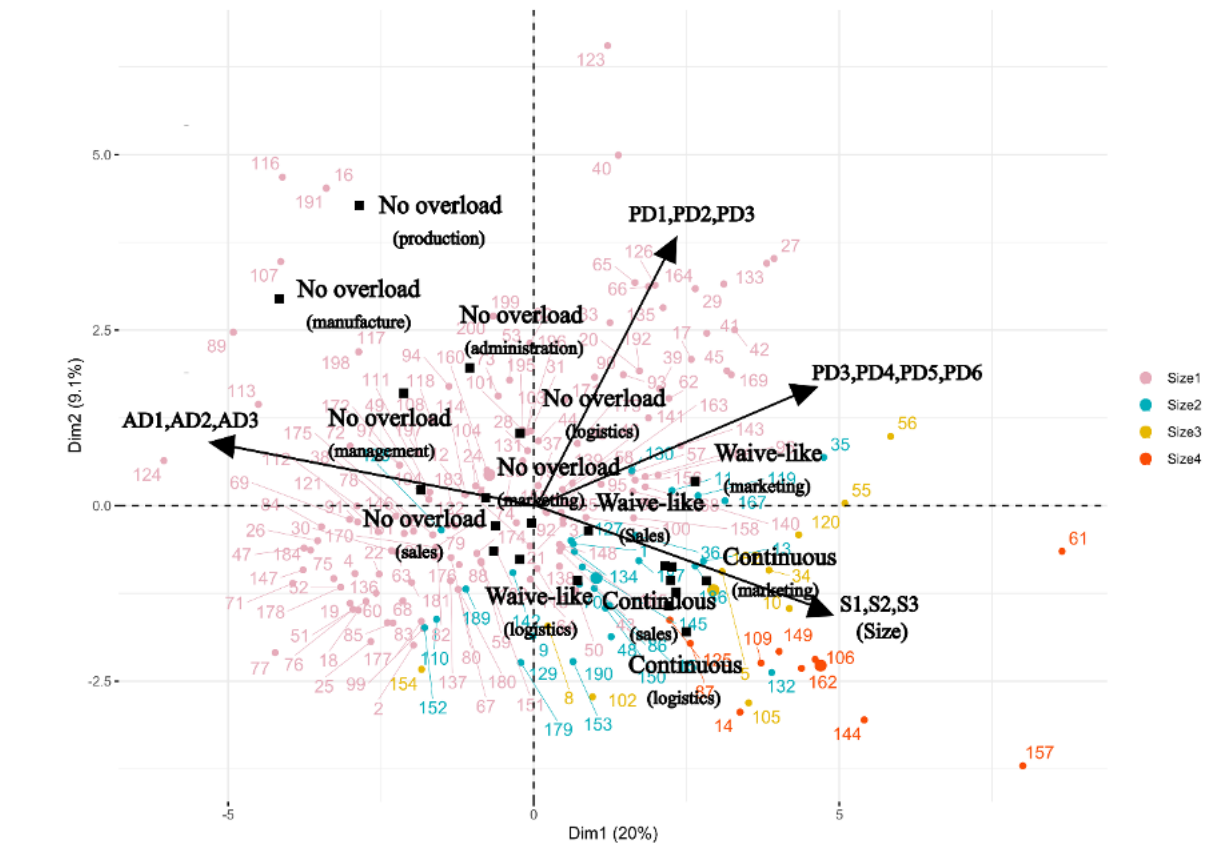
Source: own calculation

Table 3: Result of the cluster analysis and description of the clusters based on firm size

Cluster	Frequency (Silhouette index)				From HCA-Ward clustering		
	Hierarchical (Ward)	K-means (MacQueen)	K-means (Forgy)	Distribution based	Partition around medoids	Average Sales revenue in million HUF (95% CI)	Average number of employees (95% CI)
Size 1	150 (0.73)	156 (0.79)	118 (0.79)	101 (0.63)	110 (0.78)	38.5 (28.2-48.8)	3 (2-4)
Size 2	29 (0.59)	33 (0.46)	56 (0.40)	44 (0.36)	52 (0.50)	304 (275.8-332.2)	12 (8-16)
Size 3	11 (0.50)	7 (0.46)	17 (0.37)	33 (0.08)	28 (0.29)	652 (569.1-734.9)	21 (15-27)
Size 4	10 (0.31)	4 (0.46)	9 (0.39)	22 (0.15)	10 (0.41)	1829 (1369.3-2288.7)	24 (13-35)

Source: own calculation

Figure 4: Factor Analysis map of categorical and continuous factors, along with companies categorised by size



Source: own calculations

There was a significant difference between the scores of PD3-PD6 according to company size by using Kruskal-Wallis analysis as p-values were less than 5% (Fig. 3). Higher ranks indicated that larger companies rated these factors with relatively higher scores. This means that the larger the company size, the better the perceived digitalisation with respect to PD3-PD6. It was also observed that the rating of actual digitalisation was exactly the opposite of that of perceived digitalisation. These findings support the hypothesis that the actual level of digitalisation does not correspond to the perceived level. It was also found that larger companies tended to perceive digitalisation differently, especially with regard to managing potential customers/orders and customer service.

Factor Analysis of Mixed Data (FAMD) was employed to illustrate the relationships within the dataset and to highlight the main conclusions of the study. Size was found to be positively correlated with the PD3–PD6 factors and negatively correlated with the AD1–AD3 factors. No significant relationships were found between customer expectations (PD1), marketing tools (PD2), human resource development (PD7) and company size, as shown in Fig. 4. A separate investigation using Kruskal-Wallis analysis also revealed a relationship between size and process overload, but only in the case of management ($p=0.025$), sales ($p=0.026$), marketing ($p=0.027$) and logistics ($p=0.002$). Figure 4 indicates that smaller companies experienced a comparatively lower level of overload in their processes, while medium-sized companies experienced a fluctuating level of overload. On the

other hand, companies in the third and fourth size categories reported a consistently high level of overload in their processes.

DISCUSSION

The study started with an in-depth analysis of the contribution of the SME sector to the economy. The literature review emphasized the critical need for SMEs to boost their digitalisation to stay competitive and enhance their market position. Empirical research among industry experts revealed a significant gap between SMEs' perceived and actual digital maturity. In line with this, similar results have been revealed by Bonnet and Ferraris (2011) and Soule et al. (2015). Recognising the heterogeneity of the SME sector, especially the presence of microenterprises, the study highlights the urgency of strategic initiatives to strengthen competitive advantage. Although Sándor and Gubán (2021) used a different methodology, our research finds similar results, confirming that the digitalisation gap in the Hungarian SME sector is an increasingly pressing problem. In order to address this gap, the authors propose a comprehensive assessment of the digital maturity of SMEs, coupled with the introduction of accessible and customized digital solutions. Aghazadeh et al. (2024) emphasize the key role of internationalization as a pillar, which aligns with the proposed solutions. According to the findings, this strategic approach could significantly increase the actual digital maturity of SMEs, thereby helping to increase competitiveness

and operational efficiency in a highly competitive market environment.

The research challenges the perception that digitalisation is only a financial issue. It emphasises the profound impact of digital transformation on corporate culture and employee engagement, as well as the importance of the individual, as Scuotto et al. and Fachrunnisa et al. have also reported in their papers (Scuotto et al., 2021; Fachrunnisa et al., 2020). Held and his research team identified senior management support as a key factor, which aligns with the findings of our own study based on the perspectives of senior managers. In addition, Grooss and his co-authors point to the lack of other factors in digital maturity testing models that consider the role of technology rather than organizational aspects in the interpretation (Grooss et al, 2022), while Teichert's (2019) literature review highlighted the role of organizational culture and its absence in the models. In line with Cummings (2016), this study also finds that reducing monotonous tasks and using digital tools can enhance the retention of younger employees, thereby improving the overall workforce. The investigation stated that larger companies perceive digitalisation differently, especially with regard to managing potential customers/orders and customer service. This strengthened the findings of Singh et al. (2024) that there is a strong relationship between ICT and consumer behavior.

CONCLUSION

The research has highlighted the crucial role of digitalisation in enabling micro, small, and medium-sized enterprises (SMEs) to maintain and enhance their competitiveness. SMEs recognize the importance of digitalisation, and the COVID-19 pandemic has accelerated the adoption of digital tools. However, a significant gap in digital maturity remains among these enterprises. The examinations confirmed that the main barriers to digitalisation in SMEs are a lack of appropriate skills, financial constraints, and insufficient support from top management. They also revealed that perceived and actual levels of digitalisation differ across companies, and these differences are related to company size. SMEs often use only the most basic digital tools and do not make the most of

available technologies. While many small businesses use ERP systems, they may not be using them to their full potential and may only be using a limited number of modules, which can be a significant financial burden. All three business sizes use only those digital tools and programs required by government policies or customer specifications.

The investigation has identified several challenges that SMEs face as they digitize. However, the findings also provide some recommendations to mitigate these challenges and help SMEs successfully navigate the digital transformation journey. For example, in terms of training and advice, SME managers and employees need regular training and advice on how to use digital tools effectively. Training should introduce the latest technologies and trends, and provide practical knowledge on how to use digital tools. Advice should include experts to help businesses choose and implement the right digital solutions. Financing digitalisation is often a significant challenge in terms of financial support. Government and EU funds should focus on programmes and incentives to support SMEs' digitization. Financial support can help SMEs finance the purchase of necessary hardware, software and services and training costs. When considering networking, firms should be allowed to exchange experiences and find common solutions. Networking facilitates the flow of information and allows SMEs to learn from each other. In networks, businesses can develop new solutions and services and apply for grants together.

It is important to note that the results of our study are mainly relevant to the Hungarian SME sector, including HBC. However, the findings can be generalised to other countries or to similar sized companies in the country. Further research is needed to gain a deeper understanding of the SMEs' digitalisation process and to identify the factors that most influence successful digitalisation.

In conclusion, the study highlighted the critical role of digitalisation in ensuring the survival and growth of SMEs. By closing the digital maturity gap and implementing the right digital solutions, SMEs can increase their competitiveness, improve operational efficiency and foster a positive working environment.

Copyright © European Center of Economic & Social Research (Slovakia). This is an Open Access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



REFERENCES

1. Adiwijaya, K., Fauzan, R., Rohman, I. K., & Zaber, M. (2022). Do mobile applications give competitive advantage to Small and Medium Enterprises? Lessons from Indonesia. *SSRN Electronic Journal*. <http://dx.doi.org/10.2139/ssrn.4181855>

2. Aghazadeh, H., Zandi, F., Amoozad Mahdiraji, H., & Sadraei, R. (2024). Digital transformation and SME internationalisation: unravelling the moderated-mediation role of digital capabilities, digital resilience and digital maturity. *Journal of Enterprise Information Management* 37 (5), 1499-1526. <http://dx.doi.org/10.1108/jeim-02-2023-0092>
3. Bánhidi, Z., Dobos, I., & Nemeslaki, A. (2020). What the overall Digital Economy and Society Index reveals: A statistical analysis of the DESI EU28 dimensions. *Regional Statistics* 10 (2). h
4. Bánhidi, Z., & Dobos, I. (2023). A Data Envelopment Analysis model for ranking digital development in the countries of the European Union without explicit inputs and common weights analysis. *Decision Analytics Journal* 6, 100167. <http://dx.doi.org/10.1016/j.dajour.2023.100167>
5. Bonnet, D., & Ferraris, P. (2011). Transform to the power of digital: Digital transformation as a driver of corporate performance. *Digital Transformation Review* 1, 14-29. <https://www.slideshare.net/slideshow/capgemini-consulting-digital-transformation/8880170>
6. Brávác, I., & Krebsz, R. (2021). The digital development of Hungarian SMEs: Can we become digital leaders? *Kül-gazdaság - Foreign Trade*, 65 (9-10), 60-85. <https://doi.org/10.47630/kulg.2021.65.9-10.60>
7. Cummings, M. L., Gao, F., & Thornburg, K.M. (2016). Boredom in the workplace: A new look at an old problem. *Human Factors* 58 (2), 279-300. <http://dx.doi.org/10.1177/0018720815609503>
8. Csordás, A., & Füzési, I. (2019). Level of Digital Competences and the Examination the Relationship Between Unemployment and in Job-Trainings in the European Union. *International Journal of Engineering and Management Sciences* 4 (3), 197-209. <https://doi.org/10.21791/IJEMS.2019.3.19>
9. Csordás, A., Pancsira, J., Lengyel, P., Füzési, I., & Felföldi, J. (2022). The Potential of Digital Marketing Tools to Develop the Innovative SFSC Players' Business Models. *Journal of Open Innovation: Technology, Market, and Complexity* 8 (3), 122. <http://dx.doi.org/10.3390/joitmc8030122>
10. Darmoyo, S., & Weli, W. (2024). Adoption and Usage Continuity Model of Accounting Mobile Application for MSMEs. *Journal of Accounting, Entrepreneurship, and Financial Technology* 5 (2). <http://dx.doi.org/10.37715/jaef.v5i2.4655>
11. Omimakinde, J. A., & Dickson, O.F. (2022). Strategic Importance of Information and Communication Technology to the Survival of Small and Medium Scale Enterprise (SME) In Nigeria during the Covid-19 Era. *International Journal of Business and Management Invention* 11 (6), 25-33. *International Journal of Business and Management Invention* 11 (6). <http://dx.doi.org/10.35629/8028-1106022533>
12. European Commission. (2020). A digital agenda for Europe. Available at: <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0245:FIN:EN:PDF>
13. European Commission. (2022). Digital Economy and Society Index (DESI) 2022. <https://digital-strategy.ec.europa.eu/en/policies/desi>
14. Fachrunnisa, O., Adhiatma, A., Lukman, N., Ab Majid, M.N. (2020). Towards SMEs' digital transformation: The role of agile leadership and strategic flexibility. *Journal of Small Business Strategy (archive only)*, 30 (3), 65-85. <https://jsbs.scholasticahq.com/article/26349-towards-smes-digital-transformation-the-role-of-agile-leadership-and-strategic-flexibility>
15. Fan, Q., & Ouppara, N. (2022). Surviving Disruption and Uncertainty Through Digital Transformation: A Case Study on Small to Medium-Sized Enterprises (SME). In: Semerádová, T., Weinlich, P. (Eds.), *Moving Businesses Online and Embracing E-Commerce: Impact and Opportunities Caused by COVID-19*. IGI Global Scientific Publishing, pp. 1-22 <https://doi.org/10.4018/978-1-7998-8294-7.ch001>
16. Fernández-Portillo, A., Almodóvar-González, M., & Hernández-Mogollón, R. (2020). Impact of ICT development on economic growth. A study of OECD European union countries. *Technology in Society* 63, 101420 <https://doi.org/10.1016/j.techsoc.2020.101420>
17. Gunta, G. Z., & Andra, Z. (2020). Digital Readiness and Competitiveness of the EU Higher Education Institutions: The COVID-19 Pandemic Impact. *Emerging Science Journal* 4 (4), 297-304. <http://dx.doi.org/10.28991/esj-2020-01232>
18. Grooss, O.F., Presser, M., & Tambo, T. (2022). Balancing digital maturity and operational performance-progressing in a low-digital sme manufacturing setting. *Procedia Computer Science* 200, 495-504. <http://dx.doi.org/10.1016/j.procs.2022.01.247>
19. Hardiyanto, N., Rafdinal, & W., Gaffar, M.R. (2022). Predicting the Adoption of Mobile Business Applications by Culinary SMEs in Indonesia. *Journal of Management and Entrepreneurship Research* 3 (1), 46-60. <https://doi.org/10.34001/jmer.2022.6.03.1-27>
20. Hayes, A. F., & Coutts, J. J. (2020). Use Omega Rather than Cronbach's Alpha for Estimating Reliability. *But.... Communication Methods and Measures* 14 (1), 1-24. <https://doi.org/10.1080/19312458.2020.1718629>
21. Held, T., Schneider, L., & Koppenhagen, F. (2021). Digitization in procurement — challenges and success factors: A study of the current state in German-speaking companies. In: Bode, C., Bogaschewsky, R., Eßig, M., Lasch, R., Stölzle, W. (eds), *Supply Management Research: Advanced Studies in Supply Management*. Springer Gabler, Wiesbaden. https://doi.org/10.1007/978-3-658-35449-7_4
22. Hong, P., & Park, Y. (2014). *Building Network Capabilities in Turbulent Competitive Environments*. CRC Press, Boca Raton. <http://dx.doi.org/10.1201/b17918>

23. Iakovets, A., Balog, M., & Židek, K. (2023). The Use of Mobile Applications for Sustainable Development of SMEs in the Context of Industry 4.0. *Applied Sciences* 12 (1), 429. <http://dx.doi.org/10.3390/app13010429>
24. Johnson, D., & Turner, C. (2015). A digital agenda for Europe: Creating the inclusive information economy. In: European Business. Routledge, New York, NY, USA, pp. 283-302.
25. Jou, Y.T., Mariñas, K.A., Saflor, C.S., Baleña, A., Gutierrez, C.J., Dela Fuente, G., Manzano, H.M., Tanglao, M.S., Verde, N.A., Alvarado, P., & Young, M.N. (2024). Investigating Various Factors Influencing the Accessibility of Digital Government with eGov PH Mobile Application. *Sustainability* 16 (3). <https://doi.org/10.3390/su16030992>
26. Kaufman, L., & Rousseeuw, P. J. (1990). Partitioning Around Medoids (Program PAM). In: Finding Groups in Data: An Introduction to Cluster Analysis. Wiley & Sons, Inc. Hoboken, New Jersey. pp. 68-125. <http://dx.doi.org/10.1002/9780470316801.ch2>
27. Kergroach, S. (2020). Giving momentum to SME digitalisation. *Journal of the International Council for Small Business* 1 (1), 28–31. <https://doi.org/10.1080/26437015.2020.1714358>
28. Lassing, M., Müller, J.M., Klieber, K., Zeisler, A., & Schirl, M. (2021). A digital readiness check for the evaluation of supply chain aspects and company size for Industry 4.0. *Journal of Manufacturing Technology Management* 33 (9), 1-18. <http://dx.doi.org/10.1108/jmtm-10-2020-0382>
29. MacQueen, J. B. (1967). Some methods for classification and analysis of multivariate observations. In: Le Cam, L.M., Neyman, J. (Eds.), Proceedings of the fifth Berkeley symposium on mathematical statistics and probability 1. University of California Press, California, pp. 281-297. <http://projecteuclid.org/euclid.bsm/1200512992>
30. Masenya, T. M. (2023). Digital Transformation in SMEs: Developing Digital Business Model Innovations Based on Artificial Intelligence. In: Motjolopane, I., Ruhode, E., Owolawi, P.A. (Eds.), Business Models and Innovative Technologies for SMEs. Bentham Science Publisher, Singapore, pp. 62-84. <https://doi.org/10.2174/9789815196719123010006>
31. McDonald, R. P., (2013). *Test Theory*. Psychology Press, New York, NY, USA. <https://doi.org/10.4324/9781410601087>
32. Ortiz de Guinea, A., & Raymond, L. (2020). Enabling innovation in the face of uncertainty through IT ambidexterity: A fuzzy set qualitative comparative analysis of industrial service SMEs. *International Journal of Information Management* 50, 244-260. <https://doi.org/10.1016/j.ijinfomgt.2019.05.007>
33. Pagès, J. P., & Pagès, J. (2014). Multiple Factor Analysis by Example Using R. Chapman and Hall/CRC. New York, NY, USA. <https://doi.org/10.1201/b17700>
34. R Core Team. 2023. R: A language and environment for statistical computing. <https://www.R-project.org>
35. Rousseeuw, P. J. (1987). Silhouettes: a graphical aid to the interpretation and validation of cluster analysis. *Journal of Computational and Applied Mathematics* 20, 53-65. [http://dx.doi.org/10.1016/0377-0427\(87\)90125-7](http://dx.doi.org/10.1016/0377-0427(87)90125-7)
36. Sándor, Á., & Gubán, Á. (2021). Digital maturity lifecycle model for SMEs. *Vezetéstudomány - Budapest Management Review* 52 (11), 57-70. <http://dx.doi.org/10.14267/veztud.2021.11.05>
37. Scuotto, V., Nicotra, M., Del Giudice, M., Krueger, N., & Gregori, G. L. (2021). A microfoundational perspective on SMEs' growth in the digital transformation era. *Journal of Business Research* 129, 382-392. <http://dx.doi.org/10.1016/j.jbusres.2021.01.045>
38. Singh, P., Khoshaim, L., Nuwisser, B., & Alhassan, I. (2024). How Information Technology (IT) Is Shaping Consumer Behavior in the Digital Age: A Systematic Review and Future Research Directions. *Sustainability* 16 (4), 1556. <http://dx.doi.org/10.3390/su16041556>
39. Sommer, L. (2015). Industrial revolution - Industry 4.0: Are German manufacturing SMEs the first victims of this revolution? *Journal of Industrial Engineering and Management - JIEM* 8 (5), 1512-1532. <https://doi.org/10.3926/jiem.1470>
40. Soule, D. L., Puram, A., Westerham, G. F., & Bonnet, D. (2015). Becoming a Digital Organization: The Journey to Digital Dexterity. *SSRN Electronic Journal*. <http://dx.doi.org/10.2139/ssrn.2697688>
41. Sunday Chinedu Eze, Chinedu-Eze, V.C., & Awa, H. O. (2021). Studying Service SME Adoption of Mobile Marketing Technology (MMT) via Technology-Organization-Environment Framework. *International Journal of Information Systems in the Service Sector* 14 (1), 1-16. <https://doi.org/10.4018/IJISS.20220101.oa1>
42. Švarc, J., Lažnjak, J., & Dabić, M. (2020). The role of national intellectual capital in the digital transformation of EU countries. Another digital divide? *Journal of Intellectual Capital* 22 (4), 768-791. <https://doi.org/10.1108/JIC-02-2020-0024>
43. Teichert, R. (2019). Digital Transformation Maturity: A Systematic Review of Literature. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 67 (6), 1673-1687. <https://doi.org/10.11118/actaun201967061673>
44. Ward, J. H. (1963). Hierarchical Grouping to Optimize an Objective Function. *Journal of the American Statistical Association* 58 (301), 236-244. <http://dx.doi.org/10.1080/01621459.1963.10500845>
45. Zhang, C., Khan, I., Dagar, V., Saeed, A., & Zafar, M.W. (2022). Environmental impact of information and communication technology: Unveiling the role of education in developing countries. *Technological Forecasting and Social Change* 178, 121570. <https://doi.org/10.1016/j.techfore.2022.121570>