

Digital Transformation in Food Supply Chains in Central and Eastern Europe

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ABSTRACT

The phenomena of technology and digitalization have developed rapidly most recently, leaving traces in all branches of industry. With the prevalence of Industry 4.0 and with digitalization being on the rise, companies have expanded more and more successfully. Thus, in addition to global supply chains, their own supply chains have also started to develop considerably. The aim of our research is to discover the factors characterizing the digital transformation of companies in the Central and Eastern European region. This article assesses the conditions, key drivers, and barriers of digital transformation and the benefits expected by companies operating in the agricultural and food supply chains. The research is based on a questionnaire survey of over hundred companies. From the answers, models were created to each group of questions by using factor analysis. The results show that the most important motivating factors are quality improvement, market pull, and technological push impacts. The barriers identified are largely consistent with those reported in the contemporary literature. Companies expect benefits mostly from “sales and customer relations”, followed by “logistics and marketing”, and “production and sourcing”.

Keywords: Central and Eastern Europe, Digital transformation, Factor analysis, Supply chain management.

JEL Classification: O14.

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Highlights of this paper

- This study assess the conditions and benefits expected by companies through their digital strategy.
- The researched group of companies operate along the supply chain of agricultural and food industry, engaged in manufacturing, agricultural, commercial, transportation, warehousing and infocommunications.

1. INTRODUCTION

The digital transformation of companies is currently underway, and the process will continue in the coming decades. Digitalization brings significant changes in company processes and business models. As it fundamentally changes the operation of entire industries, it affects the entire global economy.

Properly implemented digitalization is a source of competitive advantage for companies, and as such it has become an issue of strategic importance. There are only few empirically supported research results on the situation of digitalization in the Central and Eastern European region and within Hungary.

The aim of our research is to learn about the factors that help and hinder the digital transformation of companies operating in the value chains of a selected domestic field (the agricultural and food industry), as well as to understand the benefits derived from the digital transformation.

2. THEORETICAL BACKGROUND

2.1. Digitalization, Digital Transformation

Before examining the digitalization of companies, it is necessary to clarify the concept of digitalization. (Interestingly, in our native language – opposite to the English terminology – ‘digitization’ and ‘digitalization’ have one single expression). Several authors have already dealt with the clarification of these concepts since the use of these words is not uniform even in the English literature.

The transformation of products and services into digital form (digitization) is relatively simple in the case of products whose primary value is their information content (such as printed publications, music, or financial services). In the case of tangible products, this is more difficult, but it is still conceivable due to the spread of 3D printing (Unruh & Kiron, 2017). The transformation into digital form affects not only the products, but also the operational processes of the company (Urbach, Drews, & Ross, 2017).

During digitalization, the company uses digital products and services to create new business models and offers new value propositions to its customers. The point is not the digital product itself, but its business use (Unruh & Kiron, 2017). Westerman (2018) also shows that technology alone does not increase competitiveness. The value of technology is that it enables the development of business processes. Ulas (2019) emphasizes that the development of the business process must be at the centre, i.e. the company must develop its business model with the help of digital technical solutions and take advantage of the opportunities provided by technology in order to gain a competitive advantage in the changing business environment. Urbach et al. (2017) points out that during digitalization, the focus is not on the technology, but on the customer.

According to Ulas (2019) digital transformation includes the digital transformation of products and services as well as digitization, but it cannot be limited to the technical process or the development of hardware and software used by the company. According to Unruh and Kiron (2017) digital transformation is a broader concept than digitalization: it occurs when new, digitally-based business models and processes restructure the entire economy.

In our research, we adopt the following position: ‘digitization’ or ‘binary conversion’ is the transformation of products and operational processes into digital form (a technical process), while ‘digitalization’ is the innovation of business models and processes by taking advantage of digital opportunities (See (Gartner, 2021a; Gartner, 2021b;

Gubán & Sándor, 2021; Legner et al., 2017; Parviainen, Tihinen, Kääriäinen, & Teppola, 2017; Ulas, 2019; Unruh & Kiron, 2017)).

By the concept of digital transformation, *we mean the digitalization of products, services, business models and processes, which permeates the entire company* (based on Ulas (2019) and partially on Unruh and Kiron (2017)).

2.2. Factors Facilitating and Hindering Digital Transformation

Digital transformation can be driven by many factors. Previous researches have also tried to assess these factors.

Yang, Fu, and Zhang (2021) divided incentives into two groups: internal and external factors. The authors identified the following two internal factors:

- Deficiencies in internal processes, which can be eliminated through digitalization so that the efficiency of operations can be increased.
- Corporate strategy, which points in the direction of digitalization.

The authors identified the following as external factors:

- Customers, who have a growing demand for digital products and services.
- Suppliers or other supply chain partners, who facilitate companies to adapt their already digitized processes.
- Competition, as digitalization can be a competitive advantage for companies that are ahead of the game.

Annosi, Brunetta, Bimbo, and Kostoula (2021) also mentioned the intention to increase competitiveness, adaptation to partners, and the compulsion to comply with regulations (e.g. data provision). Kilimis, Zou, Lehmann, and Berger (2019) case study-based research, the focus companies identified making production more efficient and increasing the level of customer service as the main motivation.

Digitalization also has its limits. Truant, Broccardo, and Dana (2021) identified the lack of resources, the lack of knowledge of appropriate techniques and procedures, the lack of data management skills, and the time-consuming nature of digitalization as the most significant limitations.

Horváth and Szabó (2019) also referred to the lack of (primarily financial) resources, time, and skills in addition to deficiencies in senior management and planning, as well as conflicting organizational interests, and the lack of cooperation. Malenkov, Kapustina, Kudryavtseva, Shishkin, and Shishkin (2021) identified the lack of a comprehensive digital strategy and vision, the high investment requirement, and the uncertainty regarding the results as the limitations of the digitalization of retail chains. Cichosz, Wallenburg, and Knemeyer (2020) found the complexity of the processes to be transformed, the lack of resources (time, money, and especially skilled labour), the difficulty of choosing the right technology, organizational resistance to change, and data security problems as the most important hindering factors for digitalization in logistics companies.

Diener and Špaček (2021) revealed the following limitations during their detailed research in the banking sector:

- Customers' unwillingness to accept digitized services.
- Resistance and insufficient skills of workers.
- Complexity of processes.
- The problem of the market situation, which makes the return uncertain.
- Strategy and management difficulties, such as risk aversion, slow reactions, lack of digital strategy, lack of management commitment, limited resources, and high costs.
- Technological limitations, such as data security concerns, implementation difficulties, and outdated systems.

2.3. Benefits From Digitalization

Parviainen et al. (2017) outlined three aspects of the possible positive effects of digitalization:

1. Increase in the efficiency of internal processes (cost reduction, improvement in product or service quality, increase in reliability, increase in employee satisfaction).
2. New market opportunities (higher level of customer service, new products and services, new business models).
3. Revolutionary new solutions (industrial paradigm shift, emergence of new roles and actors, disappearance of old ones).

The first of these can already be achieved by converting products and operational processes into digital form (digitization), while the other two can only be achieved through digitalization (Urbach et al., 2017).

The research of Truant et al. (2021) showed that the positive effects of digitalization are most noticeable in the areas of strategic planning and control, marketing, logistics, and production. However, Knudsen, Lien, Timmermans, Belik, and Pandey (2021) pointed out that in the business ecosystem, which is becoming more complex due to digitalization, the competition is stronger than ever before, and the advantages can only be maintained in the short term.

Strønen (2020) assessed the benefits expected by companies in various branches of industry, which he classified into three groups:

- a. Customers (better access to the market, more effective communication and contact with the customer, better understanding of customer expectations).
- b. Processes (downsizing, inventory level reduction, cost reduction).
- c. Business development (new services, higher level of customer experience).

Yang et al. (2021) assessed the benefits that can be realized through digitalization at the supply chain level. They classified these into four groups:

- a. Improving the efficiency of the supply chain, which can mean the production of a higher quality product, speeding up processes, reducing costs, improving flexibility or reliability.
- b. The structural transformation of the supply chain, which most often means the integration of the supply chain, i.e. improved coordination and cooperation between chain members.
- c. Sustainability from an economic, social, and environmental point of view.
- d. Improvement of innovation capacity.

2.4. Digital Maturity Models

Digital maturity models allow to assess the company's current situation, help to designate the areas to be developed or development directions, and support the monitoring of progress (Gubán & Sándor, 2021). Due to their practical use, digital maturity models are primarily developed by business analysts (System Application and Products in Data Processing (SAP), Gartner, Deloitte, McKinsey, PricewaterhouseCoopers (PwC), Lloyds Bank United Kingdom), but in recent years, the results of numerous model-creating researches have also been published in academic literature. While the first ones are typically designed for large companies or general use, among the latter, many models are specifically aimed for small and medium-sized enterprises (SMEs). A frequent criticism of the latter is that a professional consensus has not yet been formed, so the maturity of SMEs is difficult to assess in practice (Gubán & Sándor, 2021; Kljajić Borštnar & Pucihar, 2021).

The four main dimensions of McKinsey's model are strategy, culture, organization and capabilities. PwC's model examines five dimensions: processes and infrastructure, digital sales, customer engagement, people and culture (PWC, 2016). The maturity model of Deloitte (2018) evaluates the digital maturity of companies in five dimensions (customer, strategy, technology, operation, organization and culture).

Pirola, Cimini, and Pinto (2020) created a maturity model specially developed for SMEs, which gives a comprehensive picture of the situation of digitization in the production area based on five dimensions (strategy, people, processes, technology, integration).

Gubán and Sándor (2021) also developed their maturity model primarily for SMEs, in which three technical (technical solutions, hardware and software) and three organizational (ICT organization, online presence and human ICT [information and communication technologies]) organized into dimensions, the level of digital maturity can be determined based on 30 factors.

Kljajić Borštnar and Pucihar (2021) also created their model focusing on SMEs, the two main dimensions of which are digital capabilities (sub-dimensions: digital technology, the role of information technology (IT), business model and strategy) and organizational capabilities (human resources, organizational culture, management).

Overall, it can be concluded that the digital growth models created in both the business and academic spheres are multidimensional, and typically include organizational development and culture, strategy, and the customer aspect in addition to technology.

3. METHODOLOGY

After reviewing the relevant literature, we sought answers to the following research questions:

Q1. What are the conditions for digital transformation?

Q2. What motivates companies for digital transformation?

Q3. What limiting factors for digital transformation are companies facing?

Q4. What benefits do companies expect from digital transformation?

The digital maturity of companies as well as the interpretation and importance of digitalization show significant differences in different branches of industry and company size categories. The needs are different, and the possibilities and implementation formulas are varied. In order to be able to capture this diversity, we took a random sample from the population that we defined as a circle of companies that operate along the agricultural and food industry supply chains and have domestic locations.

For sampling, we used a self-developed questionnaire containing a total of 22 questions in three chapters, from which we compiled a database containing 114 statistical variables. The questionnaire was filled out between February and June 2021 with the managers of the participating companies, using the telephone interview method. (It should be noted that the survey refers to a more comprehensive research so questions related to digitalization made up about a third of the questionnaire).

Mostly agricultural and food industry companies and their immediate suppliers (such as logistics companies) were included in the database. The probability of inclusion in the sample was random. In order to maximize the reliability of the data obtained, the questionnaire was only considered completed if it was answered by strategic decision makers such as the chief executive officer (CEO)/owner of the company (53.5% of the respondents) or a top manager influencing the company strategy and IT (46.5%).

Based on staffing categories, the proportion of micro and small companies employing fewer than 49 people is 32%. The largest proportion consists of medium-sized companies (47%), making up almost half of the sample. 21% of the sample is represented by large companies, from 250 up to 1000+ employees. This means that the sample is suitable for drawing relevant conclusions in all size categories.

4. RESULTS

4.1. The Digital Transformation From a Management Organizational Point off View

The first research question (Q1) concerns the (internal) conditions that must be met, and the factors that make digital transformation possible.

Companies identified the availability of financial resources as one of the most important aspects of digital transformation. The transformation of the main processes and the transformation of the organizational structure were slightly less important for them. Transformation of the workforce structure was identified as the least important aspect. Since the high average of financial resources has a relatively low standard deviation (0.621), it can be seen that the interviewed managers declared similar opinions in this issue.

If the investigated four factors are combined by factor analysis (Kaiser-Meyer-Olkin, KMO = 0.744; $\chi^2 = 165.831$; $p = 0.000$), the total variance explained by the two emerging factors is close to 90% (Total Variance Explained, TVE = 86.160), and the combined factor weights after rotation exceed the value of 0.7) for each variable. The first combined factor can be considered the group of non-financial factors. The second combined factor is clearly the factor of financial resources. This is illustrated in Table 1.

Table 1. The importance of organizational aspects.

	Factors	
	Non-financial factors	Factor of financial resources
Transformation of main processes	0.914	
Transformation of organizational structure	0.901	
Transformation of workforce structure	0.891	
Financial resources		0.999

The importance of non-financial factors is closely related to strategic awareness. The correlation coefficient between them is 0.433 ($p = 0.000$), which indicates a moderately strong, significant relationship. This means that strategically aware businesses consider non-financial factors as important factors for digital transformation, i.e. they recognize the importance of the fact that digital transformation requires more than just financial resources.

Interestingly, the assessment of the role of financial factors in the digitalization strategy formation process does not show such a correlation ($p = 0.680$). Its assessment is completely heterogeneous among companies. It is considered as much more important in the IT industry than in other branches. In addition, companies with foreign ownership and SMEs also consider it very significant. The large company segment emphasized the importance of non-financial factors ($p < 0.001$).

4.2. Digitalization Strategy of Companies: Enabling and Limiting Factors

The transition to a digital strategy is facilitated by both external and internal factors. The purpose of the second research question (Q2) was to find out their importance. Among the respondents, the most important factor was *the rapid development of technology and the possibility of access to it*. The second most important factor during the digital transition was *the reduction of costs and the application of new commercial or business models*, but it is equally important to *prepare for changes in customer attitudes and preferences*. At the bottom of the average priority list was *the fear of falling behind competitors and regulatory changes in the industry*.

In order to manage these variables at the model level, it is necessary to form groups from them using factor analysis (KMO = 0.689; $\chi^2 = 70.713$; $p = 0.000$). The total variance explained by the three emerging factors is close to 70% (TVE = 69.798). The combined factor weights after rotation exceed the value of 0.7 in all but two cases, but

even in these two cases it is true that the factor weight is at least twice the second largest factor weight, or it exceeds 0.5 total value).

The first emerging factor is clearly the market pull, including the fear of falling behind competitors, cost reduction, regulatory changes in the industry, and changes in customer attitudes and preferences. The second factor includes technological push effects, such as new commercial or business models, the rapid development of technology and the possibility of access to it. The third factor is the improvement of quality. This is summarized in Table 2.

Table 2. Factors facilitating and promoting digital strategy.

	Factors		
	Market pull	Technological push	Quality
Fear of falling behind competitors	0.831		
Cost reduction	0.801		
Regulatory changes in the industry	0.684		
Changes in customer attitudes and preferences	0.545		
New commercial or business models		0.855	
The rapid development of technology and the possibility of access to it		0.765	
The improvement of quality			0.941

Table 2 is visually illustrated in Figure 1, where each factor group is marked with a different colour.

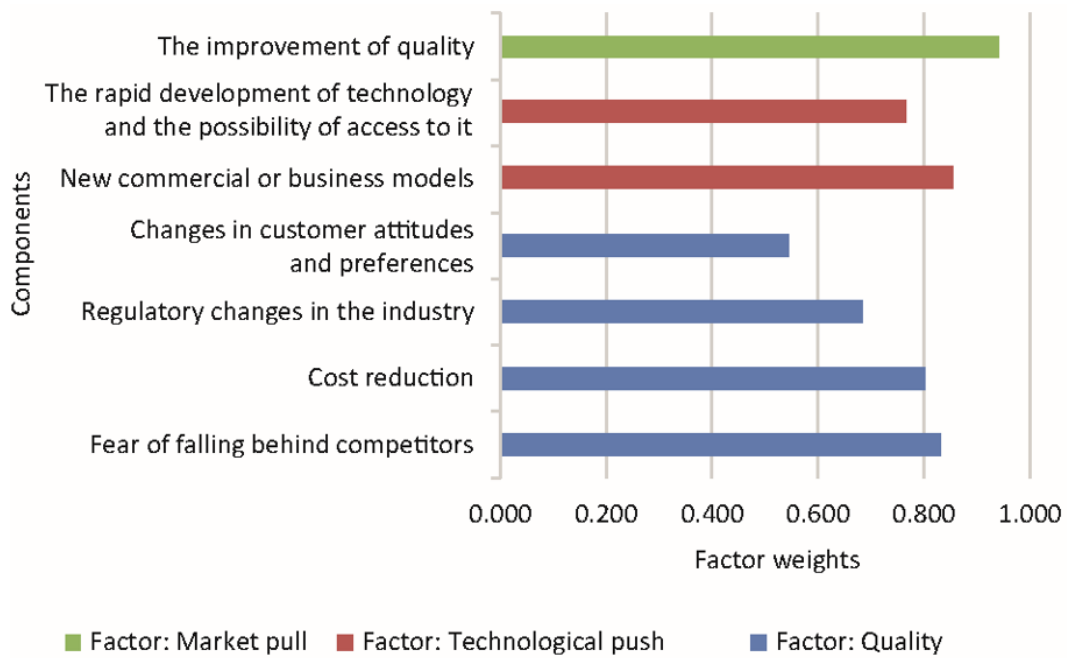


Figure 1. Representation of the factors facilitating and promoting digital strategy.

The implementation of the companies' digital strategy is not only enabled but also limited by certain factors. This is the subject of the third research question (Q3).

The biggest obstacle to the implementation of the digital strategy is that other urgent tasks related to daily operations take priority. In addition, significant difficulties may arise when transforming existing systems. Often, an appropriate employee for digitalization may be missing.

It is interesting that the lack of resources ranked only fifth in the ranking of averages. At the same time, the inhibiting effect of the corporate culture, the lack of support from senior management, and the lack of clarity were not mentioned at all.

However, in order to be able to manage these variables at the model level, it is necessary to form groups from them using factor analysis ($KMO = 0.896$, $\chi^2 = 423.516$; $p = 0.000$). The total variance explained by the single emerging factor exceeds 70% ($TVE = 71.652$). Only one of the constructs has an eigenvalue higher than one. Therefore, the nine examined variables are combined into a single factor. The factor weights exceed the value of 0.7 in all cases. This is illustrated in Table 3 and Figure 2.

Table 3. Factors hindering the implementation of the digital strategy.

	Factor weights
The company's human resources capabilities	0.908
Difficulties in transforming existing systems	0.900
Lack of resources	0.882
Lack of a person responsible for digitalization	0.867
Cyber security risks and threats	0.856
Corporate culture	0.850
It is not clear what the benefits of digitalization are	0.822
Other urgent tasks related to daily operations take priority	0.766
Lack of support from senior management	0.754

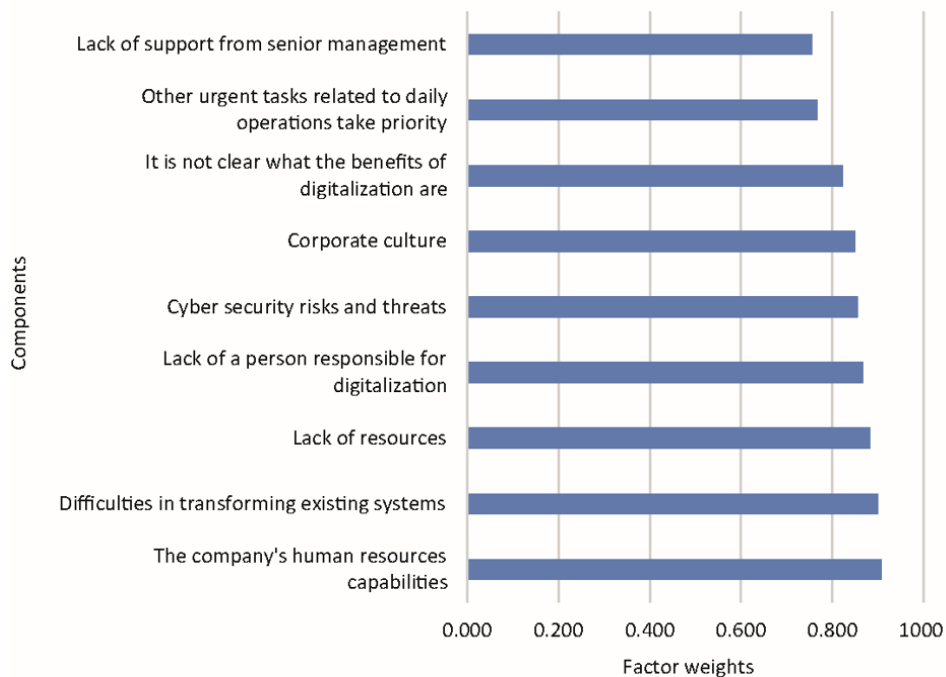


Figure 2. The importance of factors hindering the implementation of the digital strategy.

The fourth research question (Q4) concerns the areas in which the benefits from digitalization arise, and the extent to which these areas are affected.

According to the results, companies expect benefits from digitalization in the following areas:

- Sales and customer relations, followed by
- Logistics,
- Marketing, then
- Production, and

- Procurement.

In order to manage these variables at the model level, it is necessary to form groups from them using factor analysis ($KMO = 0.657$; $\chi^2 = 38.020$; $p = 0.000$). The total variance explained by the two emerging factors remains below 60%. This is summarized in Table 4 and Figure 3.

Table 4. The expected benefits from digitalization.

	Factors	
	Outflow	Inflow
Sales	0.821	
Customer relations	0.718	
Marketing	0.613	
Procurement		0.722
Logistics		0.700
Production		0.672

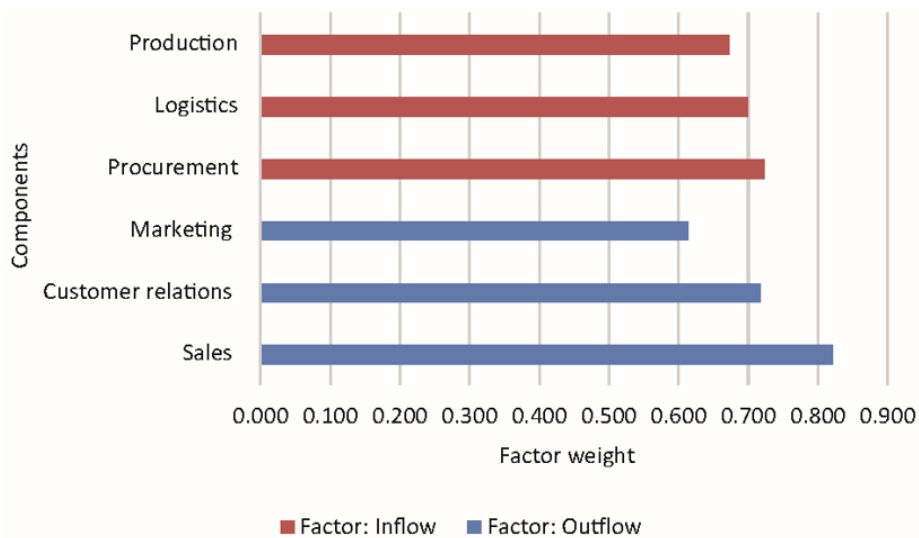


Figure 3. The benefits from digitalization.

When looking to the above components, we could form two average groups: The first combined factor might include Sales, Customer relations and Marketing.

We could name these results as *outflow process results* (i.e. the resulting benefits) as they focus on the external part of the company's value chain.

The second factor might include the trio of Procurement, Logistics and Production, which would refer to the *value-creating processes* of the upstream part. Therefore, we named them *inflow process results*.

In this paper we do not intend to examine this grouping more in detail. We will be back to the question in our next publication.

5. DISCUSSION AND CONCLUSION

The results of the research show several similarities with the literature reviewed earlier, but there are also some differences.

Among the factors that facilitate digital transformation, the making of internal processes (in production and logistics) more efficient was important in both the literature and this research. Based on the research, this can be imagined by reducing costs and improving quality.

However, the need for cost reduction appeared not as an internal motivation, but as a market pull, i.e. as an external motivating force arising from the competitive situation.

Most of the incentives identified as external factors in the literature were also confirmed in our research. The followings were important motivating forces:

- Increase in customer expectations.
- The fear of falling behind competitors.
- Compliance with regulations.

Interestingly, following new business models shows up as a kind of technological push for domestic companies, unlike the changes dictated by the company's own corporate strategy, which was suggested by [Yang et al. \(2021\)](#) for instance.

In our model, we classified as technological push the appearance of new technologies and the expanding possibilities of access to them. This factor was not included in this form in the examined models of the literature. However, it appears indirectly in these models through customer expectations and incentives coming from supply chain partners.

A further research opportunity would be to explore whether the appearance of new technologies on the market – emerging directly or through (the motivation coming from) other stakeholders, such as customers, competitors or suppliers – facilitates companies to adapt digital technologies.

Regarding the range of factors hindering digitalization, there is a relatively large consensus in the literature. However, these factors are grouped differently by individual sources. The present research did not provide a solution to this problem either, since only one factor was combined during the factor analysis, i.e. we did not find a statistically supported basis for group formation.

The assessment of individual hindering factors significantly overlapped with what was found in the literature:

- a. A significant obstacle is the complexity and intertwining of existing systems, which makes it difficult to introduce comprehensive systems.
- b. Concerns about data security are serious.
- c. The necessary human skills are lacking.
- d. Monetary resources are lacking.
- e. No one is responsible for digitalization, which suggests shortcomings in the digital strategy.

The following factors, although often mentioned in the literature (see e.g. [Cichosz et al., 2020](#); [Diener & Špaček, 2021](#); [Malenkov et al., 2021](#))) did not emerge among the companies we surveyed:

- a. The limiting effect of corporate culture.
- b. The lack of senior management commitment.
- c. The lack of knowledge about the benefits.

At the same time, as *a new limitation* we identified *the focus on everyday operational tasks*, which diverts attention and resources from digitalization.

In terms of the benefits expected from digitalization, the research confirmed *the expectations for benefits at the company level*.

The aspect of both internal processes and customer markets appeared prominently. The factor groups that emerged during the factor analysis can be well matched to [Parviainen et al. \(2017\)](#) and [Strønen \(2020\)](#) grouping, although they do not fully cover them. Out of the two factors, the outflow (customer) aspect was more prominent. Companies primarily look for benefits here, but expectations are also high in the field of logistics.

At this stage, our present research has not addressed the benefits that can be realized at the levels of supply chains and the branches of industry (see e.g. (Parviainen et al., 2017; Yang et al., 2021)) and special areas such as sustainability and innovation. Nevertheless, we have identified these as opportunities for further research.

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