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Barriers to Sustainable Digital Transformation in Micro-, Small-, and Medium-Sized Enterprises

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Abstract: Digital transformation empowers micro-, small-, and medium-sized enterprises (MSMEs) to rethink the way they make decisions and apply technology in meaningful and sustainable ways. The aim of this study is to investigate the main barriers to MSMEs' sustainable digital transformation, given their global importance and function as the backbone of any economy. We apply the concept of sustainable digital transformation (SDT), which refers to the process of digitalizing the economy in a long-lasting, green, and organic way by building on its key strength: innovative companies and their business ecosystems. The study is based on a representative survey of 425 Latvian MSMEs, which was conducted in the spring of 2021. We combine a survey of MSMEs with a qualitative comparative analysis. Our study identified seven barriers to sustainable digital transformation for MSMEs, which can be classified into three levels of importance. We found that the most important barriers to MSMEs are IT security issues and the shortage of specialists in the external labor market. Furthermore, we discovered that some barriers differ depending on company attributes, such as the number of employees, revenue, and the ability to implement digital transformation independently. However, the barriers were evaluated similarly by company owners and managers. These findings can help MSMEs' managers and owners, policymakers, and practitioners understand which barriers are impeding MSMEs' sustainable digital transformation.

Keywords: sustainable digital transformation; MSME; barriers of digital transformation; company's attributes

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1. Introduction

Companies' digital journey began some time ago, but due to the pandemic, many of the barriers to digital adoption were removed. For instance, businesses have already made significant investments that are assisting them in safeguarding their digital security and have built a technology infrastructure that enables employees to work from home offices. Furthermore, given the increasing pressure on global resources and the pressing need to reduce emissions, digital transformation can assist businesses in transforming in a sustainable manner. Despite the possibility that digital transformation opens up new horizons for businesses combining digital and environmental goals, there are numerous obstacles to overcome. In this study, we look at how companies perceive the importance of barriers to sustainable digital transformation (SDT). The SDT concept refers to the process of digitalizing the economy in a long-lasting, green, and organic way by building on its key strength: innovative companies and their business ecosystems [1]. Although academics focus on both digitalization and sustainability [2–5], our understanding of the barriers to MSMEs' SDT remains surprisingly limited. This is significant because, to ensure their sustainable journey, MSMEs must overcome challenges and select appropriate digitalization initiatives using the strategic directions provided by digital transformation. The majority of current empirical research on digital transformation [6–9] is based on case studies, limited question-and-answer surveys, or historical data on technology investment, with no generalized or longitudinal studies. Thus, increasing understanding of the barriers

to MSMEs' SDT enables longitudinal research, which is critical for stakeholders such as MSMEs, academia, and policymakers. To the best of the authors' knowledge, MSMEs' SDT barriers have not been thoroughly researched. This study addresses these literature gaps by raising the first research question:

RQ1. *What and how important are the barriers that Latvian MSMEs face during SDT?*

Previous research has not focused on attributes such as company size, ability to manage digital transformation independently, opinion of owners and managers, or revenue level [7–10]. Due to this, earlier research in this field does not accurately capture the barriers that MSMEs must overcome in order to embark on a sustainable digital journey.

As a result, the following research question arises:

RQ2. *Is the importance of SDT barriers dependent on Latvian MSMEs' attributes?*

The aim of this study is to investigate the main barriers to MSMEs' sustainable digital transformation, given their global importance and function as the backbone of any economy. This study is based on information from an online survey of 425 Latvian MSMEs' owners and managers that was conducted in the spring of 2021. To achieve the study's aim, we combined a survey of MSMEs with a qualitative comparative analysis.

The structure of this paper is as follows. Section 2 discusses the theoretical background and research questions. The data and methodology are covered in Section 3. Section 4 presents the results of data analysis for the main barriers to sustainable digital transformation, as well as insights into the research questions. Section 5 discusses the findings, and Section 6 concludes.

2. Theoretical Background

2.1. Sustainable Digital Transformation

The fact that the digital transformation phenomenon is still developing and emerging, and that sustainable digital transformation has not yet been theoretically defined, contributes to many of the difficulties associated with its comprehension. To investigate SDT, an interpretive rather than a prescriptive approach was used in this paper [11]. The interpretive approach includes social theories and perspectives that accept reality as socially constructed or made meaningful through actors' interpretation of events [12]. The value of the goods and services that businesses offer increases as a result of digitalization, and customer integration boosts long-term profitability, according to research [7,11,13,14]. Additionally, researchers noted that digitization has a positive effect on sustainability, cost reduction, revenue growth, and financial performance [8,11,15,16]. The digital transformation of MSMEs has the potential to accelerate the achievement of environmental sustainability goals [17].

The sustainability concept is often broken into three core concepts: economic, environmental, and social. Simultaneously, digital transformation is a process that alters the entire business model and requires an ecosystem, a dedicated digital strategy, and digital skills [8]. The European Commission adopted the "European GreenDeal", a long-term strategy for a more sustainable Europe, in 2019 [18]. The term "sustainable digitalization" has been appearing in the media since 2018. For example, the Sustainable Digitalization Project (SDP), a multidisciplinary collaboration drawing on diverse expertise, engaging broadly within Australia and internationally, and partnering with industry, academic, and government institutions, has been launched. "Sustainable digitalization", according to them, is digitalization that is responsible, ethical, and sustainable, providing environmental, social, and governance (ESG) benefits while carefully managing the risks of harm [19]. Additionally, the German non-governmental organizations Forum Umwelt und Entwicklung started a conversation about how, in order for digitalization to truly be a part of great social change, it must be sustainable, fair, and relevant to all people while also working for the common good. Technology has the potential to cause more and new social, economic, and ecological issues if it is not properly discussed for benefits or risks, and if democratic control and regulations are not in place [20]. The Eco-Innovation Observatory defines digital eco-innovation as "an innovative application of digital technologies that reduces

the use of natural resources (including materials, energy, water and land) and decreases the release of harmful substances, including GHGs, across the whole life-cycle of products, services or systems" [21].

The concept of SDT, as defined by the European Digital MSME Alliance in 2020, refers to the process of digitalizing the economy in a long-term, green, and organic way by capitalizing on its key strengths: innovative MSMEs and their business ecosystems [1]. A SDT was defined along three interconnected dimensions by the Digital MSME. First, sustainable business-to-business (B2B) digitalization: focusing on long-term B2B relationships rather than closed "off-the-shelf" solutions that lead to dependency. Second, green(er) technologies and a circular economy: a digital sector that conserves resources, improves efficiency, and allows products to be repaired and reused. Third, innovation-enabling policy and regulation: a comprehensive approach to rule-making that encourages innovation by emphasizing openness in software and hardware [1]. Furthermore, Germany's Federal Ministry for the Environment and Consumer Protection (BMUV) has committed to three goals of SDT: energy efficient data centres, sustainable hardware procurement, and Blue Angel eco-label certification [22].

Due to the scale, scope, and speed involved, the Nyagadza (2022) [15] study views the SDT phenomenon as an evolution of the transformation phenomenon enabled by information technology. We agree that digital transformation is a fast-moving process, and our understanding of its sustainability is still in its early stages. However, because we are looking at the efforts of MSMEs to transform, we used the European Digital SME Alliance's concept of SDT in this study. The process of digitalizing the economy in a long-term, green, and organic way by capitalizing on its key strengths: innovative SMEs and their business ecosystems, is considered SDT [1].

2.2. Barriers to Transformation

Business managers face a variety of resource challenges during digital transformation because transformation, like any change, requires resources. To address the barriers to SDT, we employ a resource-based theory (RBT). Although Wernerfelt proposed the firm's RBT in 1984 [23], there is still no agreement on the definitions of even the basic concepts and framework workings [24], which can be explained by RBT being in an emerging and developmental state. According to the authors, the evolving theory can explain the evolving process, so the changing nature of RBT corresponds well with the changing nature of SDT.

The role of RBT in developing and maintaining a competitive advantage through resource management during company digitalization is gaining popularity in academia and industry [25,26]. RBTs share a set of basic assumptions, which include theories of resource acquisition and accumulation (such as strategic factor market theory and the competitive lifecycle), theories of the firm (such as the knowledge-based view), and theories of sustainable competitive advantage (such as dynamic capabilities and the relational view) [27].

Firm-based resources can be both tangible and intangible. Tangible resources include physical assets such as financial resources and human resources, whereas intangible resources include an organization's reputation, culture, knowledge or know-how, accumulated experience, and relationships with customers, suppliers, or other key stakeholders [28]. The implementation of digital transformation is a complex process with numerous resource challenges and barriers to overcome [29]. We develop a concept that identifies barriers to sustainable digital transformation using the resource-based theory perspective (see Figure 1).

Consequently, recognizing barriers and comprehending their causes is crucial to being able to overcome them. What are the main barriers to digital transformation? Table 1 provides a summary of the literature review on identifying barriers or obstacles to digital transformation.

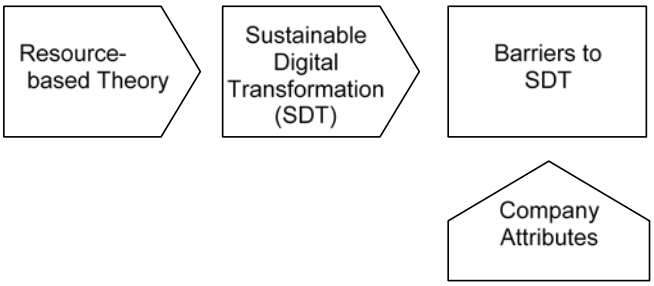

Figure 1. A framework for identifying the barriers to MSMEs' sustainable digital transformation.

Table 1. Review of the literature on digital transformation barriers.

Authors	Data Collection	Sample	Barriers
Cichosz, Wallenburg, and Knemeyer (2020) [8]	Interviews	17 experts	Complexity of logistics network and underlying processes Lack of resources, including skilled resources Technology adoption Resistance to change Data protection and security breach
Vogelsang et al. (2019) [9]	Expert interviews	46 experts	Missing skills Technical barriers Individual barriers Organizational and cultural barriers Environmental barriers
Fanelli (2021) [7]	Survey	68 SMES form 8 countries	Regulation/limited support by local policy makers Funding, lack of financial resources Lack of expertise/skills of existing employees within the firm Inability to hire new employees with relevant skills/expertise Lack of customer demand or limited interest from stakeholders Lack of appropriate external advice/technological skills High integration costs Difficulties in establishing effective collaboration with supply chain partners Competition in the industry
Truant, Broccardo, and Dana (2021) [6]	Survey	116 firms	Insufficient resources Lack of suitable skills to manage the data Lack of techniques and procedures Time consuming Data quality (poor data or lack of information) Limiting business model Lack of integration Privacy and security concerns Low internal acceptance
Abel-Koch et al. (2019) [11]	Survey	2500 SMEs in five European countries	Lack of appropriate financing possibilities IT security issues Insufficient digital skills of employees Shortage of IT specialists on the external labour market Internal resistance to change Low speed of internet connection Uncertainty about future digital standards

A review of the literature identifies a number of barriers, including a lack of suitable funding options, IT security concerns, a lack of employees with adequate digital skills, a shortage of IT specialists in the outside job market, internal resistance to change, a lack of managers with the necessary knowledge to implement change, uncertainty about future digital standards, etc. All of the identified barriers are resource-related; for example, a lack of suitable funding options is a financial resource. A company's resources for starting a business or restructuring, including digital transformation, can be divided into five broad categories: financial, human, educational, emotional, and physical resources. According to RBT, effective resource management provides a competitive advantage to the company. This is a fast-growing research area mainly focused on large companies, but some of

the literature is also devoted to SMEs [8,12]. However, the literature on the sustainable aspects of digital transformation is lacking. The following research question is addressed to investigate what and how important the barriers are for Latvian MSMEs during SDT.

RQ1. *What and how important are the barriers that Latvian MSMEs face during SDT?*

Competitive advantage refers to resources that enable a company to produce goods or services better or at a lower cost than competitors [30]. According to Michael Porter's theory of competitive advantage, states and businesses should pursue policies that produce high-quality goods that can be sold at high market prices [30]. Different characteristics, such as company size, location, corporate governance, etc., are attributed to competitive advantages [31].

Does the company's size matter? Competitive advantages based on economies of scale are frequently used to refer to supply side advantages, such as the purchasing power of a retail chain [32]. However, scale advantages exist on the demand side as well—they are commonly referred to as network effects and occur when a service becomes more valuable to all of its users as the service adds more users [32]. In terms of employee benefits, larger companies can have a competitive advantage over smaller ones [33]. Larger firms have the advantage of being able to pay higher wages and provide better jobs to their employees than smaller firms. A large corporation will frequently provide health and life insurance, stock options, retirement benefits, and employee assistance programmes. We develop a research question to address the issues raised above:

RQ2. *Is the importance of SDT barriers dependent on Latvian MSMEs' attributes?*

To investigate this broad RQ2 question in depth, we divided our RQ2 into subquestions addressing some of the company's attributes. Which barriers are causing the most difficulty for various groups of MSMEs? MSMEs are regarded as the economic backbone. They are not homogeneous, though. A micro-enterprise with few employees may experience different issues than a medium-sized business with more than 200 employees. Small businesses frequently struggle more to access high-quality digital infrastructure, deal with issues of data security and privacy, and adapt to new regulatory frameworks. According to several studies [4,9,34], a sizable portion of MSMEs have yet to invest in digital transformation and have never used any digital technology. There are various ways to estimate a company's size, but the most popular is to use its workforce. However, we also want to look at the level of revenue in addition to the number of employees. RQ2 was thus subdivided as follows:

RQ2.1. *Does the size of Latvian MSMEs affect the importance of SDT barriers?*

Numerous studies [35,36] show that SMEs are lagging behind large companies in terms of digital readiness. The industry, manager skill level, company size, and other factors all have an impact on how well prepared the MSME is for the SDT. Some MSMEs can manage digital transformation on their own, while others require public assistance from state and EU funds. Previous research has found that micro businesses in Latvia are still waiting for government assistance to begin or facilitate digital transformation, whereas medium-sized businesses are already doing so [37]. We want to know if companies see the barriers the same way or differently depending on their ability to manage digital transformation independently.

RQ2.2. *Does the ability of Latvian MSMEs to manage SDT affect the importance of SDT barriers?*

DT is more about people than technology. It is critical who implements digital strategy and how. Organizations must constantly experiment, challenge the status quo, and learn to be comfortable with failure as a result of this cultural shift [37]. Although owners of micro businesses frequently serve as managers as well, this is less common for medium-sized businesses [26]. Because of the principal-agent problem and a potential conflict of priorities between the asset's owner and the person to whom control of the asset has been delegated, we investigate owners' and managers' attitudes toward SDT barriers. Do they both place equal value on barriers, or do their perspectives differ? As a result, we develop our RQ2 subjection as follows:

RQ2.3. *Does the respondent status of Latvian MSMEs affect the importance of SDT barriers?*

3. Methodology

This study utilizes a three-stage approach. Stage 1 is devoted to a literature review. Stage 2 is based on a survey to collect factual data about the barriers to SDT from MSMEs' owners and managers. In Stage 3, we performed a qualitative comparative analysis using the Kruskall–Wallis H test to identify differences between different groups of SMEs. MSMEs were first classified according to their size. We classified MSMEs into micro-, small-, and medium-sized enterprises based on the number of employees. In addition, we classified MSMEs as having high or low revenue. Second, MSMEs were classified according to their ability to manage the digital transformation on their own. Third, we investigated the significance of barriers based on respondents' status: owners or managers. This method also allowed us to test our research questions and determine how similar or dissimilar objects really are [38].

3.1. Data Collection and Sample Characteristics

A literature review was carried out in Stage 1 to identify potential barriers in order to isolate patterns and facilitate a more precise analysis in the qualitative and quantitative sections. The survey included 17 statements and five company-specific questions about the respondent's status/position within the company, as well as information about the company's size, revenue, business models, and economic sector. With the help of a consulting firm, a survey was conducted that was primarily directed at small- and medium-sized business professional associations. The authors also communicated with representatives of MSMEs online and through oral personal meetings, phone calls, and social media sites such as LinkedIn, Twitter, and Facebook. The survey was conducted online in the spring of 2021. A seven-point Likert scale was used to collect the responses because it is the most accurate of the scales at capturing the respondent's feelings. Our questionnaires received responses from 425 MSMEs, with the sample participants being divided between micro-companies (44%), small businesses (42%) and medium-sized businesses (13%). Only MSMEs with annual revenues under 50 million euros and fewer than 250 employees make up the sample. According to the methodology used by the European Commission, the size of micro-, small-, and medium-sized enterprises was determined by the number of employees within the business [39].

Around 95,000 active businesses were registered in Latvia in 2020, and 99% of them were micro-, small- and medium-sized businesses [40]. In accordance with Yamane, 398 businesses are required for a representative sample, with a 95% confidence interval and a p value of 0.5 for 95,000 businesses [41]. Our sample is representative because it includes 425 small- and medium-sized businesses, which is more than the required 398. Appendix A in Table A1 contains descriptive statistics for the sample.

Generally, Latvian businesses are considered sustainable when it comes to greenhouse gas emissions. The so-called brown sectors (D, E, B and H, and in Latvia also A) take up 16% of total value added in 2019. Additionally, looking at our sample, we see that MSMEs considered in brown sectors take up a small percentage of the total sample (see Table 2).

3.2. Measures

We created our survey questionnaire based on the literature review that was presented in Chapter 2. MSMEs' representatives have to respond to what major or severe barriers to SDT they face in their company. SDT was defined as the process of digitalizing the economy in a long-lasting, green, and organic way by building on its key strength: innovative companies and their business ecosystems [1]. Table 3 provides a summary of the measures. Due to the fact that our sample is multi-sectoral, we tried to offer a universal combination of SDT barriers in various industries.

Table 2. Sustainability of Latvian economic sectors and research sample.

	Value Added, 2019	Sample Distribution	Carbon Intensity of Sectors (All Greenhouse Gasses), kg per Euro Value Added, 2019
Total	**100.0**	**100.0**	**0.459**
A Agriculture, forestry and fishing	4.6	14%	2.927
B Mining and quarrying	0.5	1%	0.384
C Manufacturing	12.2	13%	0.437
D Electricity, gas	1.7	2%	4.757
E Water supply; sewerage, waste management	0.9	1%	2.428
F Construction	6.5	8%	0.147
G Wholesale and retail trade	14.6	10%	0.067
H Transportation and storage	8.3	3%	1.772
I Accommodation and food service	1.9	3%	0.026
J Information and communication	5.7	7%	0.008
K Financial and insurance activities	3.1	4%	0.008
L Real estate activities	12.2	1%	0.038
M Professional, scientific and technical	4.6	7%	0.026
N Administrative and support service	3.1	2%	0.077
O Public administration and defence	7.9	0%	0.059
P Education	4.8	5%	0.020
Q Human health and social work	4.3	6%	0.046
R Arts, entertainment and recreation	2.1	3%	0.024
S Other service	0.9	6%	0.033
T Activities of households as employers; undifferentiated goods- and services	0.2	6%	

Source: Bank of Latvia [42], authors' calculated.

Table 3. Measurement items.

Questionnaire Items	Short	Source
Lack of appropriate financing options	FIN	[11]
IT security issues	IT_SEC	
Insufficient digital skills of employees	DIG_SKILLS	
The shortage of specialists in the external labour market	EMPL	
Internal resistance to change	INT_RES	
Lack of managers' knowledge of how to do it	MAN_KNOW	
Shortage of uncertainty about future digital standards	FUT_DIG_STAND	
Ability to perform digital transformation independently	DT_can	◦
Owners or staff	OWN	
Revenue	REV	

Source: authors' developed.

The responses to questions about barriers ranged from 1 (not at all important) to 7 (extremely important).

As previously stated, MSMEs are not homogeneous; their level of digital adaptation varies, and the barriers they face may also vary. In this study, we investigate the attitudes of MSMEs' owners and managers toward SDT based on their size. MSMEs are classified as micro-enterprises with up to 9 employees, small enterprises with 10 to 49 employees, and medium-sized businesses with 50 to 250 employees. To see if there were any differences based on revenue, groups 1 and 2 were investigated, with revenue ranging from 2 to 50 million euros (high revenue) and less than 2 million euros (low revenue), respectively.

Furthermore, we investigated whether SDT barriers are dependent on MSMEs' ability to complete their own digital transformation. The ability of MSMEs to digitally transform has ranged from 1 (a company cannot digitally transform on its own) to 7 (a company can manage digital transformation on its own). Then, we divided the MSMEs into two comparison groups, one in which they can independently carry out digital transformation (scoring from 5 to 7), and the other in which they cannot (scoring from 1 to 4). We assess

whether there are statistically significant differences between MSMEs of various sizes and the two groups based on their capacity to perform SDT using the Kruskal–Wallis H test.

Finally, we tested respondents' perceptions of barriers by dividing them into two groups: MSMEs' owners and managers.

4. Results

Harman's single factor test, using an un-rotated factor solution, was used to determine the existence of common method variance. Because the first factor accounted for only 27.20% of total variance (less than 50%) and the first five factors accounted for 62.84%, we can conclude that there is no common method bias. We asked fact-based questions and stressed that the information gathered would be kept confidential. Furthermore, we had digital transformation experts from several universities in Latvia, Lithuania, and Estonia review our survey questionnaire. Before releasing the questionnaire, we asked some entrepreneurs and less digitalized colleagues if the terms were clear and easy to understand. We also checked the correlation for common method bias and discovered that no measurement has a correlation greater than 0.68 [43].

The Kaiser–Meyer–Olkin measure was used to test sampling adequacy, and the result was 0.816, which is greater than 0.5, indicating that further tests can be performed. Furthermore, with a p value less than 0.000, Bartlett's test of sphericity is significant.

Cronbach's alpha can be used to determine how closely related a group of items is [44]. Cronbach's alpha for barriers in our data is 0.802, indicating that the data is reliable [44].

Table 4 summarizes the survey responses of MSMEs to what major or severe barriers to SDT they face in their company. It offers data based on the MSME's size and the mode for each barrier.

Table 4. What major or severe barriers to SDT face your company? (percentage and mode).

Barriers	1	2	3	4	5	6	7	Total	N	Mode
Lack of appropriate financing options (micro)	2%	6%	2%	6%	26%	25%	34%	100%	189	7 (extremely important)
Lack of appropriate financing options (small)	3%	4%	7%	16%	29%	24%	17%	100%	180	5 (moderately important)
Lack of appropriate financing options (medium)	4%	11%	5%	18%	34%	11%	18%	100%	56	5 (moderately important)
Lack of appropriate financing options (MSMEs)	3%	6%	4%	12%	29%	23%	24%	100%	425	5 (moderately important)
IT security issues (micro)	5%	10%	8%	20%	21%	24%	13%	100%	189	6 (very important)
IT security issues (small)	2%	11%	2%	21%	31%	29%	3%	100%	180	5 (moderately important)
IT security issues(medium)	5%	4%	9%	25%	16%	30%	11%	100%	56	6 (very important)
IT security issues (MSMEs)	4%	10%	6%	21%	24%	27%	8%	100%	425	6 (very important)
Insufficient digital skills of employees (micro)	3%	5%	6%	16%	28%	23%	18%	100%	189	5 (moderately important)
Insufficient digital skills of employees (small)	3%	5%	12%	9%	29%	32%	9%	100%	180	6 (very important)
Insufficient digital skills of employees (medium)	2%	2%	13%	9%	32%	23%	20%	100%	56	5 (moderately important)
Insufficient digital skills of employees (MSMEs)	3%	5%	10%	12%	29%	27%	14%	100%	425	5 (moderately important)
The shortage of specialists in the external labour market (micro)	3%	4%	5%	22%	26%	22%	19%	100%	189	5 (moderately important)
The shortage of specialists in the external labour market (small)	2%	4%	8%	15%	24%	39%	8%	100%	180	6 (very important)
The shortage of specialists in the external labour market (medium)	4%	5%	4%	14%	14%	50%	9%	100%	56	6 (very important)
The shortage of specialists in the external labour market (MSMEs)	2%	4%	6%	18%	24%	33%	13%	100%	425	6 (very important)
Internal resistance to change (micro)	10%	10%	12%	19%	24%	17%	10%	100%	189	5 (moderately important)
Internal resistance to change (small)	6%	9%	14%	24%	25%	18%	3%	100%	180	5 (moderately important)

Table 4. *Cont.*

Barriers	1	2	3	4	5	6	7	Total	N	Mode
Internal resistance to change (medium)	4%	11%	21%	16%	13%	23%	13%	100%	56	6 (very important)
Internal resistance to change (MSMEs)	7%	10%	14%	21%	23%	19%	7%	100%	425	5 (moderately important)
Lack of managers' knowledge (micro)	10%	10%	6%	19%	30%	14%	11%	100%	189	5 (moderately important)
Lack of managers' knowledge (small)	4%	16%	16%	21%	23%	14%	6%	100%	180	5 (moderately important)
Lack of managers' knowledge (medium)	9%	23%	23%	16%	14%	11%	4%	100%	56	3 (slightly important)
Lack of managers' knowledge (MSMEs)	8%	14%	12%	19%	25%	14%	8%	100%	425	5 (moderately important)
Shortage of uncertainty about future digital standards (micro)	5%	6%	6%	26%	23%	24%	10%	100%	189	4 (neutral)
Shortage of uncertainty about future digital standards (small)	3%	5%	7%	29%	29%	22%	4%	100%	180	4 (neutral)
Shortage of uncertainty about future digital standards (medium)	7%	7%	5%	23%	20%	32%	5%	100%	56	6 (very important)
Shortage of uncertainty about future digital standards (MSMEs)	4%	6%	6%	27%	25%	24%	7%	100%	425	4 (neutral)

Figure 2 depicts the modes of major SDT barriers based on the size of the MSMEs.

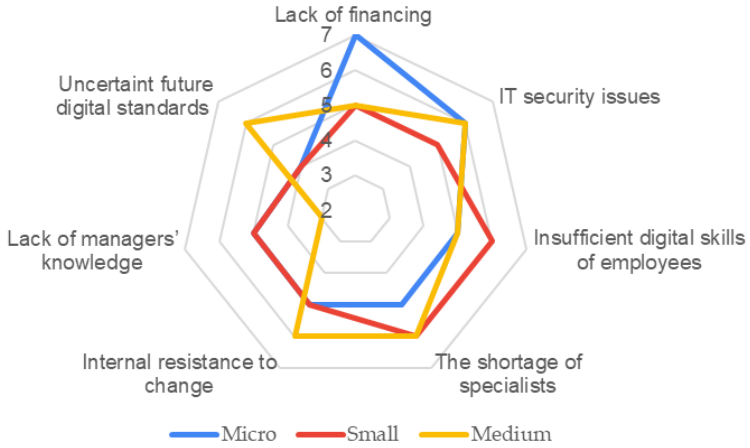

Figure 2. Major barriers to SDT faced by MSMEs, mode.

The survey analysis reveals that the most pressing issue confronting MSMEs is a lack of appropriate financing options, which has the highest percentage for answer 7 (extremely important). The estimate is so high because of micro businesses, whereas the mode for other sized businesses is only 5 (moderately important). The following barrier, with the highest percentage for answer 7 (extremely important), is a shortage of specialists in the external labor market. Again, this is largely due to small businesses. However, 33% of MSMEs estimated a shortage of specialists in the external labor market at a rate of 6 (very important). Such a pressing estimate was due to medium and small businesses, whereas micro businesses did not see it as pressing.

Analysis of the modes reveals that the SDT barriers vary depending on the size of MSMEs. For example, the most pressing issues for small businesses are employee-related barriers, a shortage of specialists in the external labour market, and employees with insufficient digital skills. In the case of medium-sized businesses, in addition to employee-related barriers, there is a lack of certainty about future digital standards and IT security issues.

In order to test our research questions, the Kruskal–Wallis H test will be used to determine whether there are statistically significant differences between the companies based on their attributes (see Table 5).

Table 5. The difference in the barriers to SDT based on the company size (Kruskal–Wallis H test).

		Test Statistics						
		FIN	**IT_SEC**	**DIG_SkILLS**	**EMPL**	**INT_RES**	**MAN_KNOW**	**FUT_DIG_STAND**
Chi-Square		23.900	0.173	1.552	1.040	0.741	12.032	0.578
df		2	2	2	2	2	2	2
Asymp. Sig.		0.000	0.917	0.460	0.595	0.690	0.002	0.749
		Mean Rank						
Size	N	FIN	IT_SEC	DIG_SkILLS	EMPL	INT_RES	MAN_KNOW	FUT_DIG_STAND
Micro	189	243.60	211.84	216.63	209.79	215.01	230.31	217.27
Small	180	194.03	212.29	205.25	211.72	207.86	209.02	207.93
Medium	56	170.70	219.19	225.63	227.97	222.74	167.38	214.88

According to the Kruskal–Wallis H test results, only two out of seven barriers are perceived differently based on their importance. Lack of appropriate financing options and lack of managers' knowledge of how to implement digital transformation have statistically significant differences between MSMEs. As a result, lack of finance is more important for micro businesses than for medium businesses, and the same is true for managers' knowledge. Yet, the variation in importance of all other SDT barriers is not statistically significant based on the number of employees. This allows us to conclude that the importance of barriers is homogeneous for the majority of barriers and that we can generalize them.

Table 6 displays the findings of a qualitative comparative analysis for two revenue-level groups.

Table 6. The difference in the barriers to SDT based on the company's revenue (Kruskal–Wallis H test).

		Test Statistics						
		FIN	**IT_SEC**	**DIG_SkILLS**	**EMPL**	**INT_RES**	**MAN_KNOW**	**FUT_DIG_STAND**
Chi-Square		41.781	10.367	0.347	1.044	0.641	5.371	0.000
df		1	1	1	1	1	1	1
Asymp. Sig.		0.000	0.001	0.556	0.307	0.423	0.020	0.991
		Mean Rank						
Revenue	N	FIN	IT_SEC	DIG_SkILLS	EMPL	INT_RES	MAN_KNOW	FUT_DIG_STAND
Low	271	241.27	198.87	215.58	217.46	209.46	223.25	212.95
High	154	163.24	237.86	208.46	205.16	219.23	194.96	213.09

The qualitative analysis reveals that the importance of barriers for both the high revenue group (from 2 million EUR) and the low revenue group (less than 2 million EUR) is statistically significant for lack of finance and managers' experience, as well as IT security issues. The lack of finance and managerial experience is more important for the low-revenue group than for the high-revenue group; whereas, IT security is more important for the high-revenue group.

Table 7 shows the results of an analysis of companies that can and cannot manage digital transformation independently.

Table 7. The differences in SDT barriers between two groups of MSMEs based on their ability to manage their own digital transformation (Kruskal–Wallis H test).

		Test Statistics						
		FIN	**IT_SEC**	**DIG_SkILLS**	**EMPL**	**INT_RES**	**MAN_KNOW**	**FUT_DIG_STAND**
Chi-Square		28.748	0.023	7.871	8.826	15.025	36.102	1.181
df		1	1	1	1	1	1	1
Asymp. Sig.		0.000	0.880	0.005	0.003	0.000	0.000	0.277
		Mean Rank						
Ability	N	FIN	IT_SEC	DIG_SkILLS	EMPL	INT_RES	MAN_KNOW	FUT_DIG_STAND
Not able	252	239.25	214.23	226.99	227.74	232.32	242.68	218.72
Able	173	175.84	212.44	193.78	192.68	185.98	170.82	205.86

The importance of barriers was influenced by the ability to manage digital transformation independently. Five of the seven barriers are perceived differently, with all of them being more important for MSMEs that are unable to manage on their own than for the second group. The significance of IT security and the uncertainty of future digital standards were perceived in the same way.

Table 8 shows the results of testing the importance of barriers based on respondent status.

Table 8. The differences in SDT barriers between MSMEs owners and managers (Kruskal–Wallis H test).

		Test Statistics						
		FIN	**IT_SEC**	**DIG_SkILLS**	**EMPL**	**INT_RES**	**MAN_KNOW**	**FUT_DIG_STAND**
Chi-Square		8.185	0.527	1.154	0.263	0.215	0.598	1.268
df		1	1	1	1	1	1	1
Asymp. Sig.		0.004	0.468	0.283	0.608	0.643	0.439	0.260
		Mean Rank						
Respondent status	N	FIN	IT_SEC	DIG_SkILLS	EMPL	INT_RES	MAN_KNOW	FUT_DIG_STAND
Owners	177	232.67	217.63	220.07	216.11	209.20	218.01	220.44
Managers	248	198.87	209.03	207.38	210.06	214.73	208.77	207.13

The analysis revealed that, with the exception of a lack of finance, company owners and managers perceived the importance of barriers in the same way.

5. Discussion

5.1. MSMEs' Barriers to SDT

We identified seven major barriers encountered by MSMEs during SDT that are common to all industries based on a review of the literature on digitalization, digital transformation, and sustainability, taking into account how this literature addresses resource issues:

Lack of appropriate financing options;
IT security issues;
Insufficient digital skills of employees;
The shortage of specialists in the external labor market;
Internal resistance to change;
Lack of managers' knowledge of how to do it;
Shortage of uncertainty about future digital standards.

Every identified barrier addresses one or more of the primary resources; for example, a lack of appropriate financing options is a financial resource, employees' lack of digital skills is

a human resource, managers' lack of knowledge about how to do it is an educational resource, and internal resistance to change is an emotional resource. Some barriers address multiple resources, such as IT security issues, which are both a physical and educational resource.

Due to their emphasis on European SMEs and substantial sample size, the Abel-Koch et al. [11] study served as the primary reference for the selection of barriers. Even though the study sample of 2500 SMEs from five countries is the most representative sample identified by the authors, it is still very small, as 500 SMEs is not a statistically significant sample for France or Germany. Yet, our sample of 425 MSMEs is statistically representative of a small country with approximately 95,000 active businesses. Furthermore, by selecting similar barriers, we were able to compare our findings. However, we did not include a barrier such as low speed internet connection, as internet connection speed in Latvia is high. Instead, because DT is a strategy that requires managers to implement, we included a barrier such as managers' lack of knowledge about how to do it. The barriers we chose are consistent with the findings of Vogelsang et al. [9]. On the basis of 46 expert interviews, Vogelsang et al. [9] identified five groups of barriers to DT: individual, organisational, environmental, and technical barriers, as well as a lack of skills. However, the barriers were discussed with interweavers within five defined barriers rather than ranked by their importance to companies. Cichosz et al. [8] identified five barriers to DT for logistics service providers; resistance to change, data protection, and security breach are similar to our barriers, but lack of resources is too broad and does not specify what kind of resources are lacking. At the same time, Fanelli [7] identified nine barriers, delving deeper into a various lack of skills; however, it overlooks such critical aspects for SDT as uncertainty about future digital standards and managers' lack of knowledge on how to implement DT.

According to a survey and qualitative comparative analysis, the most difficult barriers to SDT for MSMEs are a shortage of specialists in the external labor market and IT security issues (mode 6, very important). According to the report "The Challenges Facing European SMEs 2019", the major barrier to digital technology adoption is concerns about IT security [11], as nearly one-tenth (9%) of SMEs report that IT security issues are a very serious impediment to digitalization in their businesses, and nearly one-fifth (19%) say it is a major impediment. Truant et al. [7] discovered that the most significant barrier to the digitalization of Italian listed companies is a lack of techniques and procedures. Abel-Koch et al. [11] ranked the lack of IT specialists in the external labor market as the fourth most important barrier to digitalization. They also discovered that obstacles differ depending on the country, with resistance to change being the most important in Spain, while internet connection is the most important in Germany and France.

The next most pressing barriers for MSMEs are a lack of appropriate financing options, insufficient digital skills among employees, internal resistance to change, and managers' lack of knowledge about how to implement DT (mode 5, moderately important). According to Vogelsang et al. [9], the majority of interviewees cited a lack of skills as the main barrier to DT. The emphasis was on IT knowledge, as information and communication technologies become increasingly integrated into manufacturing processes. Cichosz et al. [8] discovered that the second most significant issue that logistics service providers face during DT is a lack of various types of resources, including a lack of time and money, but most importantly, a lack of digitally skilled employees. Additionally, the Truant et al. [7] study confirms that insufficient resources are the second important barrier to digitalization.

The lack of certainty about future digital standards was rated as less pressing by Latvian MSMEs (mode 4, neutral), whereas Vogelsang et al. [9] considered it an important environmental barrier. This disparity can be explained by Latvian companies' relatively low digital adaptation level [26], as they focus on more basic needs such as how to attract money and find skilled employees.

Despite the fact that different studies rank the most pressing barriers to digital transformation implementation differently, all of them are important for digital transformation. Other studies have revealed that the difference between first and second place is very small, and their reliability is limited, especially given that many studies are based on small sam-

ples. Given that the majority of survey or interview data is expressed as Likert scale data, which is ordinal data, the mode is the best measure of the most common responses [35]. We use a seven-point scale when addressing businesses, ranging from 7 (extremely important) to 1 (extremely less important). Our theoretical contribution to academic research is the importance-level classification of the discovered SDT barriers for MSMEs (see Figure 3).

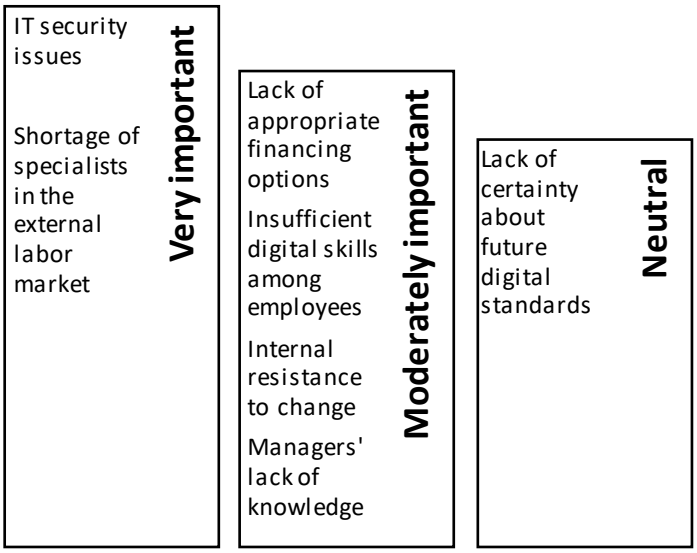

Figure 3. The classification of the importance of barriers to Latvian MSMEs' sustainable digital transformation.

The study findings address our RQ1 about the barriers and their importance for MSMEs. IT security issues and a shortage of specialists in the external labor market are the most pressing barriers for Latvian MSMEs, whereas issues such as lack of financing, insufficient digital skills of employees, internal resistance to change, and managers' lack of knowledge are less important. Even though these barriers have been empirically confirmed for Latvian businesses, a literature review allows us to generalize these findings to other countries. IT security issues and shortage of specialists in the external market both address educational resource along with physical and human, respectively. IT security issues and a shortage of specialists in the external market both address educational resources in addition to physical and human resources. This emphasizes the critical role of education in successful SDT.

5.2. The Importance of Barriers Depends on the Attributes of the Company

The qualitative comparative analysis was used to answer our RQ2 about the importance of SDT barriers based on MSMEs' attributes.

The main impediment to SDT for micro businesses, according to the findings, is a lack of appropriate financing options. According to Fanelly [7], the majority of SMEs interviewed (28%) expressed a lack of financial resources required to implement technological innovations, as well as significant difficulty in obtaining public and private funding. The most significant issue for micro businesses is that financial institutions are hesitant to lend money for risky projects involving technological solutions to a small business operating in a low-margin industry, despite the fact that innovative technology frequently necessitates a significant upfront investment. Similar conclusions were reached by Cichosz et al. [8], who stated that the impact of a lack of human and financial resources is primarily determined by the size of the company. Financial barriers are particularly challenging for small players with limited financial resources. Differences in the importance of barriers based on the size of MSMEs have also been demonstrated for other barriers. To better visualize the importance of barriers, we use different colors: "red" for extremely important, "orange" for very important, "dark yellow" for moderately important, "green" for neutral, and "light green" for slightly important (see Table 9).

Table 9. The difference in importance of the barriers to SDT based on the size of MSMEs, modes of each barrier.

Barriers/ Importance	Micro	Small	Medium	MSMEs
Lack of appropriate financing options	extremely important	moderately important	moderately important	moderately important
IT security issues	very important	moderately important	very important	very important
Insufficient digital skills of employees	moderately important	very important	moderately important	moderately important
The shortage of specialists in the external labour market	moderately important	very important	very important	very important
Internal resistance to change	moderately important	moderately important	very important	moderately important
Lack of managers' knowledge of how to implement DT	moderately important	moderately important	slightly important	moderately important
Shortage of uncertainty about future digital standards	neutral	neutral	very important	neutral

Other studies show that the importance of barriers varies depending on the size of the company or the economic activity. Cichosz et al. [8] discovered that, although a lack of skills is typically a smaller issue within larger organizations that can invest in training programmes, it becomes especially visible in smaller companies or subcontractors operating on a spot contract basis, where investment in digital skills development is not applicable due to frequent subcontractor changes. According to Cichosz et al. [8], the main difference between the impediments identified by their study and those identified by the general digital transformation literature is that people, and their resistance to change, are not the top barrier for logistics service providers.

The Kruskal–Wallis H test confirmed some statistically significant differences based on company size. In terms of a lack of appropriate financing options and managers' knowledge of how to implement digital transformation, we discovered statistically significant differences between micro-, small-, and medium-sized businesses. When we compared the differences based on revenue level, we discovered that, as with the size case, MSMEs perceived the same two barriers differently. This means that, in terms of employees and revenue, micro businesses face more pressure than small and medium businesses to attract funding and hire more skilled managers. Small and medium-sized businesses face the same challenges. For IT security issues, we discovered an intriguing result: this barrier is more important for high-revenue companies than for low-revenue ones. Again, we can explain it in terms of digital adaptation level, as high-revenue companies have met basic requirements and are now dealing with more advanced issues.

The barriers for SDT depend on the ability to manage digital transformation on their own. The analysis reveals statistically significant differences for almost all barriers, with the exception of IT security and future digital standards. To the best of our knowledge, there is no evidence from other studies how the ability to manage digital transformation affects the barriers, but according to our previous study, there is a difference in expected public support for digital transformation between these two groups [37]. The Kruskal–Wallis H test confirmed that a lack of appropriate financing options, insufficient digital skills of employees, a shortage of specialists in the external labor market, internal resistance to change, and a lack of managers' knowledge of how to implement digital transformation have varying importance for MSMEs depending on their ability to manage their own digital transformation. All of these barriers are more important for companies that are unable to perform digital transformation independently. These companies are hoping for public support to continue on their digital journey. Both groups regard IT security issues as very important, while the uncertainty of digital future standards is not regarded as particularly pressing by either group. This answers our RQ 2.2, that the barriers to SDT for Latvian MSMEs are dependent on their ability to manage their own digital transformation.

We assumed that the barriers to SDT for Latvian MSMEs vary according to respondent status (RQ2.4). Nevertheless, our analysis shows that only for one barrier out of seven, it is statistically significant. Only a lack of appropriate financing options is of different importance to owners and managers. It is more critical for owners than managers. Our results

are indirectly supported by the findings of Ivaninskiy et al. [45], who suggested that firms engaged in business digitalization have a lower level of principal-agent conflict overall.

We discovered that some of the barriers that MSMEs face differ depending on their size, revenue level, and ability to manage digital transformation independently. The significance of a lack of finance and managerial experience, in particular, was perceived differently for several attributes; whereas, the perceptions of barriers are similar among owners and managers. This provides an interesting link with resources addressing these barriers, as we noticed a high importance of educational resources for all MSMEs, then going to a more detailed company breakdown, educational resources are accompanied by financial resources. These findings support previous academic research that MSMEs are not homogeneous, and the barriers identified in this study should be addressed separately in the case of sustainable digital transformation.

6. Conclusions

We identified seven major SDT barriers for MSMEs using RBT by focusing on five major resources: financial, human, educational, emotional, and physical resources. Latvian SMEs classified identified barriers into three categories based on their importance. The most important barriers within all companies were IT security issues and a shortage of specialists in the external labor market. Both these barriers address educational resources in addition to physical and human resources. However, because the importance of barriers varies according to company attributes, different approaches to SDT implementation are required. We discovered that the importance of a lack of appropriate financing options varies across all tested groups. Moreover, with the exception of respondent status, such barriers as experienced managers varied across all tested groups.

Theoretical contribution of our research addresses four major building blocks of theory [46], which are: What? When? How, and Why?

What? The implementation of sustainable digital transformation is a complex process with numerous resource challenges and barriers to overcome. Our task was to identify the barriers that MSMEs face during their sustainable digital transformation. Relying on RBT, we identified the following barriers during a literature review: lack of appropriate financing options, IT security issues, insufficient digital skills of employees, the shortage of specialists in the external labor market, internal resistance to change, lack of managers' knowledge of how to do it, and shortage of uncertainty about future digital standards.

When? Our research is based on survey responses from 2021. COVID-19 has recently triggered another crisis; thus, scientists, entrepreneurs, and people in the research industry are faced with an entirely new global quest with economic and social impact [47]. COVID-19 is a new, unexplored aspect that has spurred the digital transformation of companies. According to McKinsey's report, COVID-19 has accelerated overall digital adoption by three to seven years in a matter of months [48].

How? Every identified barrier addresses one or more of the primary resources; for example, a lack of appropriate financing options is a financial resource, employees' lack of digital skills is a human resource, managers' lack of knowledge about how to do it is an educational resource, and internal resistance to change is an emotional resource. Some barriers address multiple resources, such as IT security issues, which are both physical and educational resources.

Why? The resource-based theory has been widely used as a managerial framework to determine critical resources for a firm to achieve a sustained competitive advantage [24]. Investigating SDT from an RBT perspective may contribute to a better understanding of the RBT conditions (VRIS—valuable, rare, imperfectly imitable, non-substitutable) associated with MSMEs resources during digital transformation. Companies will face several barriers on their digital journey, including the need to commit new, and sometimes substantial, resources to the company, employees, and customers. This RBT approach may highlight the importance of resources to support digital transformation, as owners and managers are concerned about the firm's ability to develop new capabilities.

The practical implications of this research could be directed mainly at policymakers and managers of MSMEs. Extensive scientific research proves that digital transformation [3,26,49] does not start by itself; in different sectors of the national economy, there are various triggers that launch this process. Despite the positive trend towards digitalization in general, human capital and digital integration in many MSMEs remain relatively low [50]. Significant number of MSMEs still are far away from the idea of digital transformation; hence, triggering is essential.

Our study identifies the main barriers to sustainable digital transformation, so its practical value for policymakers lies in the potential application of the study's findings to initiate the process of sustainable digital transformation among MSMEs by addressing their IT security concerns and preparing IT future specialists. Moreover, we discovered that barriers differ depending on the attributes of MSMEs. These findings imply that policymakers developing support strategies should take these differences into account in order to improve strategy efficiency. To overcome the barriers to SDT, each business must be treated as a distinct object of estimation.

The study's findings could help MSMEs managers understand the importance of investing in specific areas to overcome identified barriers. For example, a labor market shortage of IT specialists can be addressed through collaboration with educational institutions. Companies can provide grants to talented IT students in exchange for future employment. Furthermore, industry can influence university study programs by initiating needed specialties and skills for future employees. Although lack of funding is a common pressing issue for the majority of micro businesses, common issues can lead to more effective problem solving than individual issues. Different MSMEs associations can launch support programs at the national and international levels.

Digital and green transformations are currently the most widely supported processes in many countries. Efficiency gains brought about by digital transformation may speed up companies' progress toward sustainability objectives. However, the manner in which these digital solutions are built is equally important in order to avoid the introduction of new problems. In this study, we attempt to identify the major barriers that MSMEs face during their sustainable digital transformation.

Furthermore, while all barriers are distinct, they may influence one another. For example, according to Vogelsang et al. [9], the lack of standards and laws leads to fear of losing data, which can impact cultural change and the risk aversion of the company. It will be interesting to investigate the interrelationship between the barriers in future research.

Our study is not without limitations. First of all, despite a satisfactory response rate to our survey, the participants still only represent a portion of Latvia's MSMEs. Second, incorporating MSMEs from other countries would increase opportunities for international comparison and benchmarking in the discussion and future research on MSMEs' sustainable digital transformation. Third, our survey only captures participants' perspectives at one point in time. Furthermore, combining the findings of this study with case study research focusing on the removal of barriers and the development of best practices may be beneficial. The article is nevertheless useful to guide researchers and policymakers to look for barriers that actually occur in practice at the moment.

Despite its limitations, our findings provide companies and policymakers with valuable information about the most significant barriers MSMEs face during SDT, which may aid in ensuring that digital transformation occurs in a sustainable manner and supports the environmental goals of the Green Deal and Circular Economy Action Plan.

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Appendix A

Table A1. Descriptive statistics of Survey data.

	Variable Name	Min.	Max	Mode	Std. Deviation	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
DT		1	7	4.80	1.255	−0.504	0.119	0.275	0.237
BARR_FIN	Lack of appropriate financing options	1	7	5	1.545	−0.889	0.119	0.345	0.237
BARR_IT_SEC	IT security issues	1	7	6	1.563	−0.650	0.119	−0.299	0.237
BARR_DIG_SKILLS	Insufficient digital skills of employees	1	7	5	1.503	−0.771	0.119	0.093	0.237
BARR_EMPL	The shortage of specialists in the external labour market	1	7	6	1.443	−0.820	0.119	0.298	0.237
BARR_INT_RES	Internal resistance to change	1	7	5	1.653	−0.322	0.119	−0.720	0.237
BARR_MAN_KNOW	Lack of managers' knowledge of how to do it	1	7	5	1.692	−0.184	0.119	−0.859	0.237
BARR_FUT_DIG_STAND	Shortage of uncertainty about future digital standards	1	7	4	1.475	−0.622	0.119	0.016	0.237
DT_can	Ability to perform digital transformation independently	1	2	na	0.492	−0.366	0.119	−1.875	0.237
OWN	Owners or staff	1	2	na	0.491	−0.396	0.119	−1.852	0.237
REV	Revenue	1	2	na	0.370	−1.834	0.119	1.370	0.237

Source: authors' developed.

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