UNRAVELING PERCEPTIONS OF BARRIERS TO DIGITAL TRANSFORMATION – CONTRASTING SMALL AND MEDIUM-SIZED WITH LARGE ENTERPRISES

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ABSTRACT

With the proliferation of contemporary digital technologies, Digital Transformation (DT) has become a significant theme for companies across almost all industries. DT encompasses the digitalization of internal processes, the provision of digital services and products, and the enhancement of the customer experience. Previous research has delved into different barriers that impede successful DT. In our study, we investigate further how these barriers are perceived by employees at small and medium-sized enterprises (SMEs) in contrast to larger enterprises (LEs). We employ a mixed-methods approach by performing a quantitative analysis using the Means, Mann-Whitney U test with effect size and integrating it with qualitative results converted into frequencies. Our empirical data consist of two samples consisting of participants from 189 SMEs and 221 LEs for quantitative analysis and participants from 238 SMEs and 281 LEs for qualitative analysis. Overall, the results suggest a relatively similar perception of DT processes, indicating culture and structure as major barriers. However, the establishment of resources dedicated to managing DT emerges as a vaster barrier for SMEs than for LEs. At the same time, SMEs face fewer barriers regarding general personnel resources.

KEYWORDS

Digital Transformation, Barriers, Small and Medium-Sized Enterprise (SME), Large Enterprise (LE), Mixed-Methods

1. INTRODUCTION

Adopting and implementing Digital Transformation (DT) within organizations is complex, but it could introduce countless benefits for the industries and sectors involved. Leveraging DT can spark innovation and growth for the businesses that adopt it (Schmarzo, 2016). The literature defines DT as digitizing internal processes and offering digital services and products while enhancing the customer experience (Reis et al., 2018). Overall, DT aims to improve capabilities, value, and innovation for businesses in the ever-evolving digital economy (Schmarzo, 2016).

Nevertheless, specific inabilities can obstruct the DT process and, if not recognized and resolved, may generate several obstacles, thereby hindering the business from succeeding and gaining substantial market power. Consulting companies report a failure to meet business objectives at a rate of 70% (Forth et al., 2020). DT obstacles may vary in intensity and significance depending on the sector or business size. These obstacles have been identified as "barriers to DT" (Brink and Packmohr, 2022). Extensive studies have proposed instruments to measure the impact of these distinct complex barriers to DT. A review of studies on DT barriers revealed five recurring dimensions: (1) missing skills barriers, including lack of IT knowledge, information about and decision on different technologies, and process knowledge; (2) technical barriers, including dependency on other technologies, security when exchanging data, and current infrastructure issues; (3) individual barriers, such as fear of data loss or data control, fear of transparency, and concern for job loss; (4) organizational barriers, including holding on to traditional roles and principles, lacking any clear vision or strategy, resisting cultural change, having risk aversion, lacking financial resources, and lacking time; and finally (5) external barriers, such as absence of standards and lack of laws (Jones et al., 2021).

Small and medium-sized enterprises (SMEs), in particular, might face barriers in their DT, for instance, due to stronger financial constraints (Wonglimpiyarat, 2015). According to the European Union's (EU) definitions, companies are classified depending on employee headcount, their turnover, or their balance sheet total. We follow the EU definition and consider SMEs as enterprises employing less than 250 individuals. Subsequently, we consider companies with over 250 employees as large enterprises (LEs).

This research aims to explore company size as a component that might affect DT barriers. Thus, our research question is as follows: To what extent does company size affect the perception of different DT barriers? To answer our research question, we first review research on specific barriers based on company size. From a methodological perspective, we follow a mixed-method approach. We present the conducted pre-study, the quantitative data we collected, the statistical methods we used, and the qualitative data and its conversion in the method section. Thereafter, the results will be specified. In the discussion section, we discuss our results in connection to those in other studies before concluding and giving an outlook on further research topics.

SMEs are an essential economic factor (Roman et al., 2023). Thus, it is vital to understand their struggles. Compared to LEs, SMEs might need more help in DT from policymakers. Our research will contribute to a better understanding of the impact of company-size-specific constraints on DT. The literature shows that a considerable company size might be essential for extensive financial means but limited agility (Caloghirou et al., 2004). To drive progress in DT, it is imperative for companies to allocate adequate financial resources toward digitalization projects and institute agile and flexible organizational structures (Long, 2022). Hence, digital transformation (DT) serves to either augment or mitigate disparities between SMEs and LEs.

Our research reveals new perspectives on this domain. Normally, studies focus on either SMEs or LEs. Thus, contrasting these types is scarce, especially in the field of DT.

2. BACKGROUND

DT has become a buzzword with a multitude of different definitions. Scholars have combined the various definitions into a comprehensive one: "Digital Transformation is the use of new digital technologies that enable major business improvements and influence all aspects of customer life" (Reis et al., 2018, p.418). Vial (2019) assessed different DT definitions and specified the term as "a process that aims to improve an entity by triggering significant changes in its properties through combinations of information, computing, communication, and connectivity technologies" (Vial, 2019, p.121). DT is a threat to existing organizations and should, therefore, be managed adequately (Pabst von Ohain, 2019).

According to the *Oxford Dictionary* (2021), "barriers" are obstacles that keep people or things apart or prevent communication or progress. Company leaders are required to guide their organization through these barriers in the DT process. These leaders have the potential to either hinder or support the DT process, which makes them critical when it comes to managing the barriers. As DT is ubiquitous, company leaders should adopt a holistic advance to understanding and tackling the barriers to DT. If they adeptly interweave existing physical and new digital assets within the company, barriers can become facilitators; conversely, the inability to establish a connection between the two renders long-term gains unattainable, leading to falling behind even more. (Hadjimanolis, 2003; Hanelt et al., 2015).

During the review of existing literature on DT barriers, we encountered studies on specific technologies (Radhakrishnan and Chattopadhyay, 2020), specific stakeholders or sectors (Liu et al., 2011), or unordered lists of different barriers (Bilgeri and Wortmann, 2017). Furthermore, a large proportion of the studies follow a qualitative research design. Some quantitative studies exist. Again, these publications often focus on specific sectors (Khanzode et al., 2021; Stentoft and Rajkumar, 2020) or specific company sizes (Bollweg et al., 2019; Koshal et al., 2019).

Therefore, we aim to extend the research by comparing different-sized companies from various sectors. Understanding which barriers slow down DT and what specific effect each barrier has on the DT and analyzing how different-sized companies are affected by these barriers is necessary when it comes to maturing the research field and providing an understanding of DT.

We hypothesize that LEs have it easier to implement DT into their work. LEs still face challenges that create barriers, but since LEs typically work with a higher budget and more resources than SMEs, they might perceive barriers as easier to work with.

2.1 Challenges for SMEs

The goal in every industry, regardless of company size (not just tech giants), is to digitally transform. DT is a strategic imperative for companies to remain competitive in a more digitally enriched and constantly changing business environment. Every step to DT opens new possibilities for effectively extending companies' digital advantage. Currently, SMEs are experiencing the effects of this DT (Skare et al., 2023). In addition to numerous other challenges, such as financing innovation and entrepreneurial activities (Wonglimpiyarat, 2015) or finding

suitable human resources (Duan et al., 2002). Internationalization is often an issue in SMEs (Lu and Beamish, 2001) as well as digitalization (Tarutė et al., 2018). DT for SMEs comes with changes in the competitive environment, novel technologies, digital skills development, and new requirements for the leadership (Skare et al., 2023). DT is constantly changing SMEs' traditional business models and their customer value creation process (Matarazzo et al., 2021). Besides experiencing the highest inflation rate in over a decade, SMEs face further challenges in leadership capabilities provoked by increased digital capabilities. One dilemma regarding leadership capabilities within SMEs is the lack of formal qualifications among SME leaders compared to larger corporations. Instead, SME leaders are expected to learn on-site (Bolden and Rohini, 2020). Along with the qualifications, abilities, and skills to train and develop staff, having technical and managerial skills to adapt to and cope with an ever-changing environment is also fundamental in leadership roles. Given the many challenges of implementing DT while leading people, many SME leaders might fail because they might not possess the adequate skill set. Conducting a DT requires leaders to act strategically when recruiting employees. SMEs already face a lack of skilled labor, which is a critical constraint on their business activities. Thus, a major barrier to DT in SMEs is the shortage of human resources with the necessary knowledge and capabilities to meet the criteria of a DT process (Nguyen et al., 2015). A specific capability challenge is the ability to keep up to date with advances in digital marketing. Efforts could be wasted by focusing on procedures that used to work in the past. DT highly influences marketing activities because it opens new possibilities for understanding clients' and customers' behavior; for instance, the placement of individually adapted advertisements is made possible due to algorithms and the automatic collection of data (Hausberg et al., 2019).

2.2 Challenges for LEs

Larger companies face challenges due to their size. One of the most common challenges they face is the complexity of monitoring performances in all business areas. They must choose the right key performance indicators (KPIs) to provide the business with insights into success or failure. Most business people are not experts in developing these KPIs but must understand their implications (Veleva, 2009). However, enhanced digitalization can make KPIs more reliable, collect real-time data, and evolve into Business Activity Monitoring (Wetzstein et al., 2008). Moreover, larger companies' complex structures can hinder innovation and change. They tend to have a more articulated list of desired outputs compared to SMEs, making it more difficult to align with change or innovation and find a suitable balance between exploration and exploitation (Del Vecchio et al., 2018). Another challenge for larger companies is that they work in silos, meaning that different departments work almost individually without adequate coordination. At best, these silos provoke specialization and make the work more effective. At worst, they can create a mentality where the departments are so separated that they do not share any knowledge or collaboration and only work towards their own department goals. Thus, a silo mentality might prevent companies from making achievements (de Waal et al., 2019).

3. METHOD

3.1 Pre-Study

In a pre-study, we identified initial barrier dimensions regarding DT. Interviews with experts in or in charge of DT projects in their organizations resulted in the initial data series. We used semi-structured interviewing techniques to conduct 46 interviews between March 2017 and October 2018. Social network platforms were used to contact friends and acquaintances in the personal and professional realms to find participants. The participants received questions about the perceived DT hurdles in their organizations and were asked to briefly describe their businesses, the state of DT, and any potential obstacles. By interviewing participants from various businesses and occupations, we were able to gather a broad sample that would enable maximum comprehension (Yin, 2014). The interviewees were employed in the DACH region (Germany, Austria, and Switzerland).

We used an inductive coding methodology to analyze the transcripts of the interviews (Mayring, 2014). The codes related to the barriers were collectively and iteratively updated. To provide a comprehensive analysis, a socio-technical viewpoint was used throughout the coding (Sarker et al., 2019). These steps produced the first DT barrier model with the dimensions missing skills, technical, individual, organizational, and external barriers (Brink and Packmohr, 2022). The five dimensions and their characteristics are revised in Table 1.

Table 1. Initial barrier model

Dimensions	Characteristics
Missing skills	IT knowledge, information about and decisions on technologies, process knowledge
Technical barriers	dependency on other technologies, security (data exchange), current infrastructure
Individual barriers	fear of data control loss, fear of transparency /acceptance, fear of job loss
Organizational & cultural barriers	keeping traditional roles/principles, no clear vision/ strategy, resistance to cultural change/mistake culture, risk aversion, lack of financial resources, lack of time
Environmental barriers	lack of standards, lack of laws

3.2 Quantitative Study

Based on the literature, we added the dimension DT process (Klötzer and Pflaum, 2017) as the dependent variable to the initial barrier model. The DT process is the aim companies strive for, and it contains value creation and a customer perspective. The DT process does not represent a barrier dimension but enables us to capture a brief status quo of the DT in our study participants' companies. Based on our pre-study, we developed a questionnaire. We collected data between December 2019 and April 2021 (Brink and Packmohr, 2022) by applying a convenience sampling technique (Etikan, 2016) and putting out calls for participation on personal and professional network sites. All participants completed the same anonymous and voluntary questionnaire hosted by the online survey application LimeSurvey (2023).

After the data collection, we cleaned and further organized the dataset. We removed 23 participants' data as some of the answers were missing or incomplete, especially regarding the size of the company. After excluding the 23 incomplete answers, a total of 410 participants answered our questionnaire, of which 189 came from SMEs and 221 from LEs. Diversification allows one to gain the most insights from a sample (Yin, 2014). Therefore, we surveyed participants with managerial responsibility, age, and sector affiliation differences. Our sample comprises data from sectors such as the automotive industry, finance and insurance, food, information and communication technology, and mechanical and plant engineering. The broad sample allows for drawing generalized conclusions. Table 2 provides an overview of the sample.

The participants specified their level of agreement or disagreement concerning the items of the barrier dimensions on a symmetric 5-point Likert scale. The Likert scale is the most widely used approach to scaling responses in quantitative survey research and measuring perception. A 5-point scale is simple to understand and not too overwhelming for the participants as they can easily choose an inclination and balance between a high or a low agreement/disagreement (Nemoto and Beglar, 2014). The scale we used ranged between "I disagree" (1) and "I agree" (5). In total, our quantitative questionnaire encompassed 36 items. To prevent contextual bias, we developed and separated 18 positive items and 18 negative ones. Therefore, we had to re-pole the reversed items for the later analyses. For the five barrier dimensions, we modified the positive items by switching their Likert scales symmetrically into negative connotations. This ensured the same scale orientation. A high value thus represents a high degree of the respective barrier. Since the dimension DT Process, in contrast to the barrier dimensions, represents something positive, we reversed the polarity of the negatively formulated items to positive ones. Accordingly, a high value in the DT process represents a high degree of DT in the company.

After the data preparation, we conducted a first exploratory data analysis by calculating means to answer our research question. We further performed a Mann-Whitney U (MWU) test to analyze whether the observed differences in the means between the SME and LE data are statistically significant or not (Pallant, 2005), as well as to compute the effect size (r). The effect size determines the magnitude of the difference; a high overlap of the two groups is expressed by a low r-value, and a low overlap of the sample is expressed by a high r-value (Fritz et al., 2012).

Table 2. Study sample

Sector distribution			Position distribution			Age distribution		
	SME	LE		SME	LE		SME	LE
Automotive	40%	21%	Executive Manager	11%	5%	61 or older	1%	1%
Logistics	2%	7%	Employee with personnel responsibility	25%	25%	51–60	8%	7%
Finance & Insurance	1%	25%				41–50	16%	18%
Food	1%	4%	Employee without personnel responsibility	47%	55%	31–40	22%	23%
Information and Communication Technology	10%	5%				21–30	49%	51%
Mechanical & Plant Engineering	16%	9%	Intern	7%	8%	20 or younger	4%	0%
Energy	6%	4%	Other	10%	7%			
Other	24%	25%						

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3.3 Qualitative Study

To verify and extend our result, we added qualitative data collection and analysis. As a starting point, we used the same pre-study and the initial barrier model derived from it. Next, we triangulated our initial model to verify and extend it. To do this, we used an anonymous online poll to obtain additional qualitative data. With the same process used to select interviewees, we recruited 340 participants. Non-random sampling is a legitimate method for examining a domain, although it could introduce bias (Stern et al., 2017). As a result, additional participants from four companies were also included who replied to social network calls. In this phase of data collection, the random sampling methodology was used. As a result, 185 additional people freely completed the same poll.

Table 3. Questionnaire sample

Criteria	Attribute [Relative share of participants]
Sector	Automotive [18%] | Construction [13%] | Finance & Insurance [14%] | Food [7%] | Information and communications technology [3%] | Mechanical & plant engineering [9%] | Wholesale [16%] | Other [20%]
Position	Manager [6%] | With personnel responsibility [26%] | Without personnel responsibility [59%] | Other [9%]
Employees	>= 250 [52%] | 0-249 [45%] | Not stated [3%]
Age	<31 [33%] | 31-40 [20%] | 41-50 [19%] | >50 [17%] | not specified [11%]

Thus, between December 2019 and April 2021, 525 completed surveys were gathered using both random and non-random sampling techniques. 60% of the participants were from German-speaking countries. Cross-national statistics were obtained because the sample included participants from both European and non-European countries (such as Turkey and the US). Table 3 reveals the dominance of the automobile industry but to a smaller extent than in Table 2. Additionally, few participants oversee staff. The majority of participants are contracted by LEs. Most of them are under 31, which is the youngest age category.

One thousand four hundred thirty-six statements about barriers were obtained from the poll. Based on the dimensions and features established in the initial model, the survey responses were coded using the deductive method. We modified and expanded the initial model because not all 1,436 of the claims could match the original structure (Azungah, 2018). Each contributor independently openly coded the 466 unfitting sentences. The codes were then combined and debated with invited colleagues to arrive at the amended dimensions and attributes. To ensure trustworthiness and consensus, we followed debating rules (Nowell et al., 2017). A viable triangulated DT barrier model with social and technical components was produced as a result of this methodology (Hirsch-Kreinsen, 2016). After, all 1,436 of the statements were deductively re-coded using the triangulated model as the coding standard.

The triangulated model encompassed 29 DT barriers allocated into seven dimensions (cf. Table 5). The dimensions cover barriers of missing skills, technology, organizational misalignment, corporate culture, structural mismatch, regulatory restrictions, and market restrictions (Brink et al., 2022a).

Lastly, we used the re-coded data to assess the frequency of claimed DT barriers according to the company size of SMEs and LEs. Following this approach, we combined our qualitative analysis with quantitative results. Having the same type within our results will make comparing both data collections more straightforward. In mixed-method studies, converting data types is a

valid procedure (Creswell, 2015). In the end, we displayed the proportions of the respective DT barriers per company type in Table 5.

4. RESULTS

4.1 Quantitative Results

To arrive at our results, we compared the means on certain dimensions and characteristics between SMEs and LEs. We also checked whether the differences in the mean values are significant and, if so, how extensive these differences are. At first glance, both groups score surprisingly similarly in every barrier dimension and in the DT process, as shown in Table 4. In detail, differences become visible.

In the DT process dimension, the most noticeable deviating results are regarding offers of significantly improved smart products/services to the customers (DT1) and the absence of roadmaps to use smart products/services internally (DT2). For DT2, the deviation is −0.66 (3.32 for SMEs compared to 3.98 for LEs) and 0.50 for DT3 (2.66 for SMEs compared to 2.16 for LEs). No significant differences could be observed in the process of offering improved digital support for work (DT4). However, the mean values are relatively high in both groups. Both types of companies move ahead regarding their DT (DT5) but to different degrees: SMEs score 3.30 compared to 3.74 for LEs, leading to a difference of −0.44 between both groups.

Within the dimension of individual barriers, both groups' perceptions are relatively similar. A significant deviation is shown within the control of the digital workspace and the generation of data within the workspace (IND2). SMEs see this more as a problem than LEs (2.79 to 2.54), leading to a difference of 0.25 and a small effect size. The Mann-Whitney U test does not show significant differences for the other items of this dimension, indicating a similar response behavior. Further, the mean values of the individual barrier items are relatively low, indicating the participants' positive attitude towards DT.

Table 4. Questionnaire results

Dimension	(Code) Item	AVG.		MWU test	
		SME	LE	Sig.	r
DT Process	(DT1)* Company has no roadmap to offer smart products/services.	3.32	3.98	.000	.291
	(DT2) Company offers significantly improved smart products/services to customers.	2.66	2.16	.000	.211
	(DT3)* Company has no roadmap to use smart products/services internally.	2.37	2.10	.010	.128
	(DT4) Company offers improved digital support for my work.	3.30	3.17	.151	.071
	(DT5) Company is moving straight ahead in terms of a DT.	3.30	3.74	.000	.212
	(DT6)* Company still uses traditional methods for production/services.	2.53	2.28	.047	.098
Ind.	(IND1) DT is intimidating to me.	2.70	2.55	.211	.062

Dimension	(Code) Item	AVG.		MWU test	
		SME	LE	Sig.	r
Barriers	(IND2)* I control the digital workspace and the data generated.	2.79	2.54	.005	.140
	(IND3) I am afraid that, during my work, data is generated in the background, allowing conclusions about my work behavior.	1.83	1.73	.260	.056
	(IND4)* Traceability of my data does not influence my work behavior.	2.93	2.91	.837	.010
	(IND5) More jobs will be lost than gained through DT.	2.68	2.73	.754	.015
	(IND6) DT will have a negative effect on my job prospects.	1.92	1.91	.898	.006
	(IND7)* I am a strong advocate of DT as I expect process gains.	2.31	2.18	.156	.070
Orga. Barriers	(ORG1)* Senior management supports DT and is visibly engaged.	2.38	2.16	.031	.106
	(ORG2) We have no new roles in managing digitalization projects.	2.78	2.27	.000	.183
	(ORG3)* A clear strategy for DT is communicated.	2.90	2.47	.000	.192
	(ORG4)* Errors are used to improve work processes.	2.50	2.38	.220	.060
	(ORG5)* We strive to constantly learn and improve to master DT.	2.37	2.17	.146	.072
	(ORG6)* There is an openness to new ideas.	2.21	2.11	.280	.053
	(ORG7) We do not have enough resources to manage DT.	2.96	2.74	.041	.101
Tec. Barriers	(TEC1) My work suffers from a poor data connection.	3.26	3.41	.212	.139
	(TEC2) My work suffers from insufficient data interfaces.	3.19	3.50	.005	.178
	(TEC3) While exchanging information, my company fears data theft.	3.03	3.45	.000	.034
	(TEC4)* My confidential work data is sufficiently protected.	2.39	2.36	.485	.158
	(TEC5)* Company's infrastructure can handle DT.	2.57	2.23	.001	.091
	(TEC6)* Company's infrastructure is flexible for future developments.	2.61	2.37	.066	.139
Ext. Barriers	(EX1)* Through DT, data from different areas are more effectively integrated into my digital workspace.	2.36	2.35	.978	.001
	(EX2) There are enough standards to manage DT effectively.	3.16	3.45	.001	.157
	(EX3)* Legislation sufficiently protects companies in the digital world.	2.96	2.84	.361	.045
	(EX4) There are not enough laws to protect me in the digital workspace.	3.03	3.20	.130	.075
Missing Skills	(SKL1)* My IT knowledge is adequate to keep up with DT.	2.44	2.56	.192	.064
	(SKL2)* Company's IT knowledge is adequate to keep up with DT.	2.67	2.56	.338	.047
	(SKL3) There is a knowledge lack about the potential of DT.	2.96	2.89	.464	.036
	(SKL4) There is a lack of knowledge to use digital technologies effectively.	3.61	3.73	.365	.045

Dimension	(Code) Item	AVG.		MWU test	
		SME	LE	Sig.	r
	(SKL5) I would like to be more involved in the decision-making on the implementation of new technologies.	3.39	3.73	.001	.162
	(SKL6) Company should provide more training in technology skills.	3.88	4.05	.139	.073
*reversed item; MWU – Mann–Whitney U test					

In general, the dimension of organizational barriers also shows relatively low means for both groups. However, we noted significant deviations and small effect sizes in the lack of roles to manage DT projects (ORG2) and the absence of clear strategies (ORG3). Both barriers are perceived as stronger within SMEs, where ORG2 is stronger by 0.51 and ORG3 by 0.43. We were also able to observe a significant difference in the perception of the existence of sufficient resources to manage the DT (ORG7) and the perception of supportive management (ORG1). Here, the questionnaire participants from SMEs perceive the lack of resources and senior management support as slightly more severe barriers. For the other three items, we could not find any significant differences.

Looking at the overall total average of the technical barriers, they score a bit higher for LEs (2.81) compared to SMEs (2.77). While exchanging information, SMEs fear the theft of data (TEC3) significantly less than LEs, with a difference of −0.42. Despite TEC3, both groups scored rather low and significantly differently on problems regarding infrastructure to handle DT (TEC5). SMEs perceive infrastructure as less problematic than LEs by a difference of 0.34. The LE participants reported insufficient data interfaces (TEC2) significantly more than their SME counterparts, but again, the effect size is small. Meanwhile, we observed no difference in response behavior for TEC1 and TEC6.

External barriers score around 3.00, representing a tendency toward the middle of the Likert scale. However, the absence of standards (EX2) seems significantly more prevalent in LEs (−0.29). This is the only item of the external barriers for which we were able to demonstrate a significant difference with the help of the Mann-Whitney U test.

The highest mean values for both groups are observed in the dimension of missing skills. Moreover, this dimension is of interest because we were only able to measure a significant difference between the groups for one item: The provision of more training in technologies (SKL6) scored remarkably high in both groups. Further, the question of involvement in decision-making on the implementation of new technologies (SKL5) is perceived as an important barrier. However, there is a significant deviation of −0.34 between SMEs (3.39) and LEs (3.73). Surprisingly, employees in SMEs and LEs see their own IT knowledge as a minor barrier (SKL1). The response behavior for the other items in this dimension is also similar in both groups.

In sum, we identified differences and similarities in the response behavior of the two groups of participants. We found differences between both groups to be significant in 17 out of 36 items. However, the effect size values show that although the differences are significant, the overlap between the two groups is large; that is, the differences are measurable but small.

4.2 Qualitative/Quantitative Results

In the following, Table 5 shows the frequencies of the dimensions and characteristics found in the material for the triangulated barrier model. Thus, we combined a qualitative analysis with

quantitative results. The columns named dimension and characteristics show the results of the data triangulation. We set up a barrier model with the broad dimensions of missing skills, technical barriers, organizational mismatch, corporate culture, structural mismatch, regulatory restrictions, and market restrictions. The characteristics define more specific aspects of the broader dimensions. The column company size shows the relative frequencies of how often a certain characteristic was mentioned in the qualitative data according to participants stemming from SMEs or LEs. The column difference shows the delta in the perception between SMEs and LEs.

In the dimension of corporate culture, we recognize the highest difference of -3.43 between SMEs' and LEs' perceptions. Although the value is high for SMEs, too, they perceive this less as a problem. At the same time, corporate culture, together with the structural mismatch, accounts for roughly half of the perceived barriers in both categories. Within the corporate culture, sticking to the status quo displays the highest deviation with a value of -2.35. Thus, this barrier bothers SMEs less than LEs. Interestingly, lacking personal resources poses a smaller barrier for SMEs, with a deviation of -1.04. On the contrary, the lack of financial resources is a greater barrier for SMEs, with a deviation of 1.25.

Other dimensions with high impact are the missing skills, the technical barriers, and the organizational misalignment. Elevated differences between SMEs and LEs exist in the perception of the missing knowledge on the potential and the insufficient training and learning. On both characteristics, the SMEs score higher (1.03 and 1.31). Within the technical barriers, deficient IT infrastructures are perceived as a major barrier characteristic within both enterprise categories. Participants from SMEs perceive the isolation of IT systems as a smaller problem, with a difference of -1.00 compared to LEs. On the contrary, SMEs fear more security issues than LEs, with a difference of 1.68. The characteristics within the organizational misalignment are relatively evenly distributed. The lack of a DT roadmap is more of a barrier to the perception of LEs' participants. In comparison, SMEs' participants perceive the lack of change management as a more difficult barrier.

The dimension regulatory and market restrictions account for small frequencies of barriers. On all regulatory characteristics, the SMEs perceive more barriers and, thus, score higher. This pattern changes a bit for the market restrictions. Besides the restrictive value network, the market restrictions are more perceived as a barrier by LEs.

Table 5. Barriers to digital transformation in terms of company size in %

| Dimension | Characteristics | Company Size | | Difference |
		< 250	> 250	SME - LE
Missing Skills	Missing organizational knowledge	1.98	2.42	-0.44
	Missing DT potential knowledge	2.43	1.40	1.03
	Missing implementation knowledge	1.52	1.66	-0.14
	Missing user technology knowledge	2.43	2.46	-0.03
	Insufficient training & learning	8.97	7.66	1.31
	Overall	**17.33**	**15.58**	**1.75**
Technical Barriers	Deficient IT infrastructure	11.09	10.66	0.43
	Isolated systems	1.98	2.98	-1,00
	Security issues	2.74	1.06	1.68
	Missing technical support	1.06	1.25	-0.19
	Overall	**16.87**	**15.94**	**0.93**

Organizational Misalignment	Lacking DT roadmap	3.95	5.24	-1.29
	Immature decision-making	1.98	2.21	-0.23
	Lack of change management	5.17	3.17	2.00
	Lack of communication	3.19	4.28	-1.09
	Overall	**14.29**	**14.90**	**-0.61**
Corporate Culture	Deficient innovative spirit	2.58	2.36	0.22
	Missing error culture	1.22	1.18	0.04
	Sticking to the status quo	12.31	14.66	-2.35
	Diffuse fears & insecurities	4.10	5.87	-1.77
	Silo thinking	1.52	1.09	0.43
	Overall	**21.73**	**25.16**	**-3.43**
Structural Mismatch	Bureaucracy	1.82	2.18	-0.36
	Process complexity	2.28	1.50	0.78
	Lack of financial resources	9.88	8.63	1.25
	Lack of personnel resources	7.45	8.49	-1.04
	Over-aged employee structure	2.74	2.84	-0.10
	Overall	**24.17**	**23.63**	**0.54**
Regulatory Restrictions	Restrictive laws	0.76	0,00	0.76
	Volatile & obscure legislation	0.91	0.69	0.22
	Lack of political engagement	0.91	0.28	0.63
	Overall	**2.58**	**0.97**	**1.61**
Market Restrictions	Lacking customer pull	0.91	1.75	-0.84
	Restrictive value network	1.37	0.74	0.63
	Volatile technology environment	0.76	1.35	-0.59
	Overall	**3.04**	**3.84**	**-0.80**

5. DISCUSSION

The objective of our research is to understand and compare the perception of DT in SMEs and LEs. Our hypothesis when starting this research was that the company size might affect the perception of the different DT barriers. As a start, we used the initial dimensions we identified in a pre-study, namely the DT process as target and individual, organizational, technical, and external factors, and missing skills as barriers. Additionally, we set up a triangulated model, which partially differs from the initial model. One of the main differences is that the dimension of individual barriers dissolved into the characteristic of diffuse fears and insecurities. Thus, the aspects are still part of the model but on a less aggregated level. Also, individual employee aspects might play less of a role in comparisons between SMEs and LEs. The mostly non-significant differences within the dimension of individual barriers in Table 4 support the claim of rearranging this dimension. For the triangulated model, the external barriers were split into regulatory restrictions and market restrictions. Even if their impact is small, they cover different aspects of external effects in which the market restrictions have more focus on the value chain. Instead, the triangulated model includes organizational misalignment and corporate culture as new dimensions, specifying the former organizational barriers into formal management aspects and informal values. Other scholars identified 12 barriers through a literature review. A lot of these barriers are related to strategy or management. However, cultural barriers are mentioned less in the analyzed literature (Mahmood et al., 2019).

Within the DT process, offering improved smart products and services to customers and implementing road maps for using smart products and services internally seems to be of utmost

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importance. In our study, SMEs tend to have greater problems offering smart products and services, which is surprising as we expect SMEs to be closer to the customer and better at exploring markets. SMEs might have to think more about engaging with the customer, as it will affect product and process innovation (Wahyuni and Sara, 2020). On the other hand, we see LEs more prepared to meet customer demands by forecasting (Del Vecchio et al., 2018). In contrast, SMEs are in lesser need of road maps. One reason may be that LEs have a more expanded and complex business structure, which can hinder innovation and prevent any rapid changes within the business. The size and complex structure might lead to decelerations and delays of DT strategy announcements within LEs due to organizational silos (de Waal et al., 2019). Silos might separate departments from each other and make it harder to spread the word across their borders. Another low-scoring item can emphasize this speculation: LEs tend to move straight ahead in terms of DT to a lesser extent than SMEs.

Within the individual dimension, employees in both groups are not afraid of conclusions regarding their work behavior. Either employees trust their employers to be ethical, or the legal framework is substantially developed (Kidwell and Sprague, 2009). On the contrary, employees perceive a higher threat of being unable to control their digital workspace, which affects more participants from SMEs than LEs. IT adoption is normally slower in SMEs, which might lead to further insecurities related to other barriers we measured, such as fear of data theft.

Within the organizational barriers, we see the lack of resources affecting SMEs to a higher degree when it comes to management roles for DT. Human resources especially pose a barrier for SMEs (Duan et al., 2002). Surprising are the results for communicating a clear DT strategy. We expected a higher barrier perception for LEs since silos hinder the communication of strategies (de Waal et al., 2019). "DT strategy" might be the keyword to explaining the low perception result: Without proper management roles for DT, a DT strategy might not evolve and, thus, cannot be communicated.

Since the number of staff may be higher and the different departments may be divided and segregated in LEs (de Waal et al., 2019), the data connections might also need to reach a wider area and include more people within LEs. This may create stability issues within the data connection and provoke a greater fear of theft while exchanging data. Meanwhile, SMEs perceive higher barriers regarding their infrastructure, which we can relate to higher obstacles in acquiring resources (Wonglimpiyarat, 2015).

In the external barriers, the lack of laws scores relatively high, which aligns with the rather high score of the individual barrier concerning an absence of control in the digital workplace. Thus, there is a need to implement digital workplace protection and a better legal framework (Forradellas and Garay Gallastegui, 2021). In particular, improving technical standards, which pose a higher barrier for LEs, will contribute to many benefits for LEs. Nonetheless, without a proper cybersecurity strategy (Ani et al., 2017), companies could face a lot of vulnerable and assailable fronts.

In the missing skills dimension, the perception of some sub-barriers is relatively high, especially the lack of knowledge regarding the use of technologies, involvement in decision-making, and training. Again, we can relate some of these barriers to the issue of resources. Interestingly, LEs tend to score higher on the aforementioned barriers. Regarding decision-making, employees in LEs tend to be less involved because of more hierarchy and bureaucracy (Bourdieu and Coleman, 2019). Regarding the training, we expected a higher value with SMEs because of a general lack of resources, which could lead to less formal training than on-the-job training. There is a need for more proper training planning (Hulla et al., 2021) to help employees articulate their missing skills thoroughly. Otherwise, the pragmatic impacts of overcoming these DT barriers might be overlooked.

Since SMEs and LEs face different strengths and opportunities, both can succeed by focusing on their unique managerial implications. SMEs can leverage their agility, innovation, and entrepreneurial spirit, while LEs can leverage their resources, scale, and market position to achieve their business objectives (Analoui and Karami, 2003). SMEs are often more agile and flexible than LEs, enabling them to respond quickly to market or business environment changes. This can be advantageous in industries where speed and innovation are critical (Chan et al., 2019). Moreover, it would be wise for LEs to address the repercussions of silos to remain competitive and agile in the quickly changing business environment. By promoting collaboration, streamlining processes, leveraging technology, and providing effective leadership, LEs can break down silos and achieve greater innovation and efficiency (Tett, 2015).

The triangulated findings show that the barrier dimensions of Corporate Culture and Structural Mismatch have a significant impact on the two categories. The most important barrier in the eyes of LEs is typically corporate culture. Corporate Culture is less formal and more difficult to modify as a business grows than a structural mismatch. Companies deal with a stronger desire for change, particularly during a DT journey. Changes frequently encounter fierce resistance and eventually fade away. Scholars advise a reflexive approach needing consistency and expressiveness to deal with cultural change (Alvesson and Sveningsson, 2015). The more formal organizational characteristics of a corporation, which can be explained through rules or processes, are taken up by structural mismatch. Compared to SMEs, it appears to be less of a barrier for LEs. Hierarchical structures are the cause; generally speaking, LEs have stricter hierarchies than SMEs. Formal techniques, like the Balanced Scorecard, have been employed in DT settings (Yamamoto, 2020) and support the management of organizational structures (Kaplan, 2009). It's interesting to note that the Balanced Scorecard may enable double-loop learning (Li et al., 2021). This means managers can improve their conceptualizations of the company culture and the business system. Therefore, despite the fact that culture is viewed as being more informal and structural mismatch as being more formal, these characteristics cannot be dealt with independently.

Lack of financial resources hinders SMEs more than LEs, according to prior research (Eggers, 2020), which is supported by our study. LEs frequently have public listings, which increases their range of financing options. Surprisingly, LEs score lower in the absence of personal resources than SMEs, which also have challenges in finding adequate people resources (Eller et al., 2020). However, LEs see less of a barrier from inadequate training. This may indicate that LEs actively educate their personnel to compensate for labor market deficiencies. By applying additional financial resources, LEs could prevent a deficit of personal resources. LEs can draw talent with a more individualized work environment and career prospects. Due to a lack of resources, SMEs struggle to meet legal requirements (Sirur et al., 2018). They frequently engage in more local operations, have closer personal contact with suppliers and customers, or are active in niche markets (Dosi et al., 2015), which gives them marginally better tools to deal with market restrictions.

6. CONCLUSION

Our study aimed to investigate the effects of company size on the perception of different DT barriers. SMEs appear to be going through a smoother DT process than LEs. Interestingly, this seems to transpire despite the lack of different resources and capabilities within SMEs. They often handle barriers such as building leadership capabilities on-site (Bolden and Rohini, 2020). Other than expected, SMEs are doing slightly better than the LEs with the DT implementation.

LEs' struggles with DT barriers are often related to their size. Larger companies' bureaucratized systems and complex networks can hinder innovation, change, and articulation of strategies compared to SMEs. If these barriers are solved, DT can potentially improve innovativeness (Niu et al., 2023).

Our study found several notable differences between SMEs and LEs regarding the perception of DT barriers. Based on the quantitative findings, the main differences encompass having a roadmap to offer smart products/services or having no new roles in managing digitalization projects. According to our qualitative results, distinct perceptions arise concerning barriers like sticking to the status quo and lacking change management. These differences might be caused by bias in the data, although our sample is somewhat balanced between SMEs and LEs. Even, we combined two data collections, which should reduce the bias. We surveyed the companies' DT process but lacked deeper information on their maturity. In our discussion, we developed patterns for explanations. Still, further explorative research is needed to investigate these differences. Additional, more substantial, and varied results between SMEs' and LEs' perceptions of the DT process and its implementation could transpire with a larger data sample. Collecting more data and narrowing this study down by emphasizing specific sectors, industries, age groups, and levels of responsibility might generate additional insights. Further research should also address ways of overcoming barriers to DT (Brink et al., 2022b).

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