COMPARING BARRIERS TO DIGITAL TRANSFORMATION BETWEEN SMALL AND MEDIUM-SIZED AND LARGE ENTERPRISES

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ABSTRACT

With the rise of modern digital connectivity technologies, Digital Transformation (DT) is now an issue for most companies across almost all industries. DT is an evolution to digitalizing internal processes, offering digital services and products, and improving the customer experience. Prior studies have explored different barriers that hinder successful DT. Our study follows a quantitative design to explore further how these barriers are perceived by staff at small and medium-sized enterprises (SMEs) compared to larger enterprises (LEs). Our sample comprises participants from 189 SMEs and 221 LEs. In general, results indicate a somewhat similar perception of their DT processes. In detail, setting up new positions to manage DT poses a more intense barrier for SMEs.

KEYWORDS

Digital Transformation, Small and Medium-Sized Enterprises, Large Enterprises

1. INTRODUCTION

Implementing and adopting Digital Transformation (DT) within organizations is complex, but it could introduce countless benefits for the industries and sectors at hand. Leveraging DT can spark innovation and growth for the companies involved (Schmarzo, 2016). Literature defines DT as digitizing internal processes and offering digital services and products while enhancing the customer experience (Reis et al., 2018). Overall, DTs aim 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 sorted, may generate several obstacles, thereby hindering the business from succeeding and gaining substantial market power. Consulting companies report a failure rate to meet business objectives of 70% (Forth et al., 2020). DT obstacles may vary in intensity and significance depending on the sector or company size. These so-called hindrances have been identified as barriers to DT (Brink and Packmohr, 2022). Extensive studies and research have proposed instruments to measure the impact of these distinct complex barriers within organizational DT. Comparing different studies, recurring dimensions of barriers were recognized as: missing skills barriers, IT knowledge, information about, and decision on different technologies and process knowledge; the technical barriers with their dependency on other technologies, security when exchanging data, and the current infrastructure; individual barriers where the sample showed fear of data loss or data control, fear of transparency and acceptance along with a concern for job loss; the organizational barriers where holding on to traditional roles and principles, lack of any clear vision or strategy, and the resistance to cultural change, risk aversion, lack of financial resources and lack of time are some of the issues, and finally; the external barriers with its absence of standards and lack of laws are of significance (Jones et al., 2021).

Especially SMEs might face barriers in their DT, e.g., due to stronger financial constraints (Wonglimpiyarat, 2015). According to the European Union's standard, there are numerous variations and categories of companies depending on employee headcount, as well as either their turnover or their balance sheet total. These are classified as micro, small, and medium-sized enterprises, also known as SMEs

(Lu and Beamish, 2001). We follow these classifications and consider SMEs as enterprises employing less than 250 individuals. Subsequently, we consider companies above 250 employees as large enterprises (LEs).

This research aims to explore the additional component company size that might affect the DT barriers. Thus, our research question is: To what extent does company size affect the perception of the different barriers?

To answer our research question, we will first revise research on specific barriers regarding company size. After, we present the quantitative data collection and statistical methods used, which leads to the result section. In a discussion, we will revise the connection of our results to other scholars' studies before concluding and giving an outlook. 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. The literature shows that a considerable company size might be essential for extensive financial means but a limited agility (Caloghirou et al., 2004). We could argue that DT increases or levels out differences between SMEs and LEs. Thus, our research reveals new insights into this field of tension.

2. BACKGROUND

DT has become a buzzword that can have a multitude of different definitions. Scholars combined the various definitions: "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 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. The company's leaders are required to guide their organization through these barriers in the DT process. These leaders have the potential to either hinder or slow down the DT process, which makes them critical when it comes to managing the barriers. As DT is ubiquitous, managers should adopt a holistic approach to the barriers to DT. If the corporate managers can interweave these physical and digital layers, then the barriers can turn into facilitators, and failing to combine both assets instead leads to failure in long-term gains, which then leads to falling behind even more (Hadjimanolis, 2003; Hanelt et al., 2015). During the review of existing barrier research and literature, we came across 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 barrier 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 the specific effect each barrier has on the DT, as well as analyzing how different-sized companies are affected by these barriers, are 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

DT is a strategic imperative for companies to remain competitive in a digitally disrupted and constantly changing business environment. Currently, SMEs are experiencing the effects of this DT (Skare et al., 2023), besides numerous other challenges such as in financing innovation and entrepreneurial activities (Wonglimpiyarat, 2015) or in finding suitable human resources poses challenges (Duan et al., 2002). Often, internationalization is an issue for SMEs (Lu and Beamish, 2001) as well as becoming more digital (Tarutė et al., 2018). DT for SMEs comes with changes in the competitive environment, novel technologies,

digital skills development, and new requirements for leadership (Skare et al., 2023). DT is constantly changing SMEs' traditional business models and customers' value creation process (Matarazzo et al., 2021). The goal in every industry, regardless of company size – and not just tech giants - is to digitally transform. Besides experiencing the highest inflation rate in over a decade, SMEs face further challenges provoked by the increase in digital capabilities affecting leadership capabilities. Every step to DT opens new possibilities for extending the company's digital advantage most effectively. However, one dilemma regarding leadership capabilities within SMEs' is the lack of formal qualifications among SMEs' leaders compared to larger corporations. Instead, SME leaders are expected to learn on-site (Bolden and Rohini, 2020). Having technical and management skills that can adapt to and cope with an ever-changing environment is also fundamental, as well as the qualifications, abilities, and potential to train and develop staff. Given the many challenges of implementing DT while leading people, a lot of leaders of SMEs might fail because they might not possess the adequate skill set. Conducting a DT requires leaders to act strategically when recruiting employees. SMEs are already facing a lack of skilled labor, which is a critical constraint on their business activities. Thus, a crucial 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 an ability to keep up to date with developments in digital marketing. Efforts could be wasted by focusing on procedures that used to work. Still, marketing activities are highly influenced by DT as DT opens new possibilities for understanding clients' and customers' behavior due to the placement of individually adapted advertisements, which is made possible due to algorithms and the automatically generated collection of data (Hausberg et al., 2019).

2.2 Challenges for LEs

Also, larger companies are facing challenges due to their size. One of the most common challenges these larger-sized companies face is the complexity of monitoring performances in all business areas. Choosing the right key performance indicators (KPIs) to provide the business with insights about success or failure is key. Most businesspeople are not experts in developing these KPIs but must understand their implications (Veleva, 2009). Also, enhanced digitalization can make KPIs more reliable, collect real-time data, and evolve into Business Activity Monitoring (BAM) (Wetzstein et al., 2008). Larger companies' complex structures can hinder innovation and change. Often, larger companies tend to have a more articulated list of desired outputs when 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 to work in different silos, meaning 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 don't share any knowledge or collaboration and only work towards their own department goals. Thus silos might prevent companies' achievements (de Waal et al., 2019).

3. METHOD

In a pre-study, we identified the main barrier dimensions regarding DT. The dimensions are missing skills, technical, individual, organizational, and external barriers (Brink and Packmohr, 2022). Based on the literature, we added the dimension DT process (Klötzer and Pflaum, 2017) as the dependent variable. The DT process is the aim companies strive for. It contains a value creation and a customer perspective. The DT process does not represent a barrier dimension but enables capturing a brief status quo of the DT in the respondents' 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 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. In total, 410 participants answered our questionnaire. Looking at the distribution, 189 came from SMEs and 221 from

LEs. Diversification allows one to gain the most insights from a sample (Yin, 2014). Therefore, we survey respondents with managerial responsibility, age, and sector affiliation differences. Our sample comprises data from sectors such as Automotive, Finance & Insurance, Food, Information and Communication Technology (ICT), and Mechanical & Plant Engineering. The broad sample allows for drawing generalized conclusions. Table 1 gives an overview of the sample.

The participants' responses from the questionnaire were collected and registered on a symmetric 5-point Likert Scale. The respondents specified their level of agreement or disagreement concerning the items of the barrier dimensions. The Likert Scale is the most widely used approach to scaling responses in quantitative survey research and measures perception. A 5-point scale is simple to understand and balances higher- and lower-point scales (Nemoto and Beglar, 2014). The scale used was ranging 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 along with 18 negatives. Therefore, we had to re-pole the reversed items for the later analyses. For the five barrier dimensions, we modified the positive ones 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 have reversed the polarity of the negatively formulated items to positive ones. Therefore, 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 test (MWU) to analyze whether the observed differences in the means between the SMEs and LEs data are statistically significant (sig.) 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 1. Questionnaire 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%
ICT	10%	5%				21-30	49%	51%
Mechanical & plant eng.	16%	9%	Intern	7%	8%	20 or younger	4%	0%
Energy	6%	4%	Other	10%	7%			
Other	24%	25%						

4. RESULTS

Within our results, we compare the means on certain dimensions and characteristics between SMEs and LEs. We also check 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 at every barrier dimension and the DT process, as shown in table 2. 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). Both types of companies (DT5) move ahead regarding their DT but to different degrees. SMEs score 3.30 compared to 3.74 for LEs, leading to a difference of -0.44 between both groups. No significant differences could be observed in offering improved digital support for work. However, the mean values a relatively high in both groups.

Within the dimension of individual barriers, both groups' perceptions are relatively similar. A significant deviation is shown within the generation of data and the conclusion on work behavior (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 doesn't 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 a positive attitude of the participants towards DT.

Table 2. Questionnaire results

Dimen- sion	(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. Barriers	(IND1) DT is intimidating to me.	2.70	2.55	.211	.062
	(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 knowledge lack to use digital technologies effectively.	3.61	3.73	.365	.045
	(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 on technology skills.	3.88	4.05	.139	.073
	*reversed item				

In general, the dimension of Organizational barriers also shows relatively low means for both groups. At the more detailed level, we note significant deviations and small effect sizes in the missing roles to manage DT projects (ORG2) and an absence of clear strategies (ORG3). Both barriers are perceived as stronger within SMEs. Thus, ORG2 is 0.51 stronger and ORG3 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, questionnaire participants from SMEs perceive a lack of resources and senior management support as slightly more severe barriers. For the other three items, we could not find any significant differences.

The technical barriers in general score a tad higher for LEs. While exchanging information, SMEs fear significantly less the theft of data than LEs (TEC3), 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. In LEs, participants significantly reported more insufficient data interfaces (TEC2). Again, the effect size is small. For TEC1 and TEC6, differences in response behavior are not observed.

External barriers are seemingly placed in the middle of the scores. 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 missing skills. Moreover, the 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 on technologies (SKL6) scored remarkably high in both groups. Also, the question of involvement in decision-making on the implementation of new technologies (SKL5) is perceived as an important barrier. However, a significant deviation of -0.34 between SMEs (3.39) and LEs (3.73) can be observed. 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 response behavior between SMEs and LEs. We found differences between both groups to be significant at 17 out of 36 items. However, the effect sizes show that although differences are significant, the overlap between the two groups is large, i.e., the differences are measurable but small.

5. DISCUSSION

The objective of our research is to gain an understanding of the perception of DT in SMEs contrasting LEs, and vice versa. Our proposition to start this research was that the company size might affect the perception of the different DT barriers. We used the same dimensions as identified in a pre-study, such as the DT process as target and individual, organizational, technical, external, and missing skills as barriers.

Within the DT process, an improvement regarding the offering of smart products and services to customers and implementing road maps for using smart product services internally seem of utmost importance. In our study, SMEs tend to have greater problems in 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 for this 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 cause for this might be decelerations and delays of DT strategy announcements within LEs due to silos (de Waal et al., 2019). Silos might delimit departments from each other and make it harder to spread the word across silos' borders. Another lower-scoring item can emphasize this speculation for LEs to move less straight ahead in terms of DT than SMEs.

Within the individual dimension, employees in both groups are not very 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 affecting more participants from SMEs. As IT adoption is normally slower in SMEs, this might lead to other insecurities also related to barriers we measure, such as fear of data theft.

Within the organizational barriers, we see the consequences of a 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). Surprisingly are the results for the clear DT strategy. We expect a higher barrier perception for LEs, as silos hinder the communication of strategies (de Waal et al., 2019). A reason might be the keyword DT strategy. Without proper management roles for DT, a DT strategy might not evolve and, thus, cannot be communicated.

Since more staff and the different departments may be divided and segregated (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. SMEs perceive higher barriers regarding their infrastructure, which we can relate to higher obstacles in acquiring resources (Wonglimpiyarat, 2015).

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

In Missing Skills, the perception of some sub-barriers is relatively high, especially within the knowledge of the use of technologies, involvement in decision-making, and training. Again, we can relate some 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 expect a higher value with SMEs because of a general lack of resources. This lack 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 to articulate their missing skills thoroughly. Otherwise, the pragmatic impacts of overcoming these DT barriers might be overlooked.

Since SMEs and LEs face different managerial implications, both can succeed by focusing on their unique strengths and opportunities. 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 backlash of silos to remain competitive and agile in the rapidly 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).

6. CONCLUSION

Our study aimed to investigate the effects of company size on different DT barriers. SMEs perceivably are going through a smoother DT process than LEs. Interestingly, this is seemingly done despite the lack of different resources and capabilities within SMEs. Often, barriers such as building up leadership capabilities are handled on-site (Bolden and Rohini, 2020). Other than expected, SMEs are doing slightly better than the LEs with the DT implementation.

LEs might face struggles since these challenges exist due to the company's size. Larger companies' intense systems and networks can hinder innovation, change, and articulating strategies compared to SMEs.

Our study found some unexpected differences between SMEs and LEs regarding the perception of DT barriers. These unexpected differences might be because of bias in the data, although our sample is somewhat balanced between SMEs and LEs. We surveyed the companies' DT process but lacked deeper information on their maturity. In our discussion, we developed patterns for explanations. Further explorative research is needed to investigate these differences. Some additional, more substantial, and varied results between SMEs' and LEs' perception of the DT process and its implementation could transpire with a larger data sample. After collecting more data, 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., 2022).

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