

SMEs Innovation Leveraged by Digital Transformation During Covid-19



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Abstract The Covid-19 pandemic of the last few years has affected many enterprises, especially SMEs. Difficult market access, supply issues, and labor problems have characterized their business environment. Despite these challenges, some SMEs decided to stand out by innovating and investing in digital technologies to develop a new way of doing business during this period. However, little is known about the benefits that these initiatives have had in creating value for these SMEs. To answer this question, we studied two SMEs that have successfully developed new products and simultaneously implemented technological initiatives to significantly improve their processes and counter the challenges related to the pandemic. Inspired by the “S⁴” integrated digital transformation framework, we demonstrated that the numerous benefits that emerged from these innovations contributed to creating value for these SMEs in a COVID-19 context.

Keywords Digital transformation · Product innovation · Digital innovation · Value creation · Small and Medium Enterprises (SMEs)

1 Introduction

The Covid-19 pandemic has affected all economic sectors, including small and medium enterprises (SMEs) (Adam and Alarifi 2021). Government policies in many countries have resulted in temporary or even permanent closures for enterprises that have not been able to deal with the challenges of this period, including those related to supply chain disruption (Baig et al. 2020). To survive and respond to new market demands, some SMEs have chosen to innovate (Clauss et al. 2022) and seize new opportunities (Wenzel et al. 2021). A recent survey of 711 Canadian SME managers

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revealed that half revised their business model during the pandemic. In addition, for 16% of the SMEs surveyed, this period led to the development of new products, services, markets or customers (Québec Innove 2020). Also, more than half (55%) of these SMEs carried out accelerated digitization projects during the pandemic. As a result, new business models and processes have emerged to adequately respond to the COVID-19 pandemic challenges (Cukier et al. 2021), and digital technologies that would typically take five years to implement were adopted in only eight weeks by accelerating digitalization and digital transformation (DT) (Baig et al. 2020). These initiatives have propelled SMEs to innovate and rethink their business entirely to face crises and help them develop a significant advantage in a post-COVID-19 recovery (Roper and Turner 2020).

DT is used interchangeably with digitization (digitization or digitalization) (Gong and Ribiere 2020). Both are important for businesses. Nonetheless, DT is different from digitization since digitization strengthens the value proposition and the identity of companies by supporting existing activities. DT aims to transform them, changing the dynamics driving businesses' value proposition and identity (Wessel et al. 2021). DT is based on superior connectivity and an explosion of available data, changing the way enterprises do business (Mosconi et al. 2019). DT goes beyond technical or technological aspects, which frequently implies the development of new strategies, new business models, and new capabilities helping organizations to become more sustainable, integrated, efficient, agile, and adaptable to the market and to fierce competition based on innovation around value creation (Bordeleau et al. 2021).

Although innovation appears to be a winning strategy, it also brings challenges (Perin et al. 2017). A significant number of projects do not reach completion, leading to loss of resources and financial distress. In a context of high uncertainty, risk-taking increases, and rates of failure in innovation projects are high (D'Este et al. 2016; Jenson et al. 2016; Maslach 2016). Rhaïem and Amara (2021) indicate that 40–90% of innovation projects end in failure. In addition, accelerated DT opens many occasions for digitization of innovation processes, and outcomes can disrupt existing innovation management practices since it becomes difficult for a business to separate the relationship between innovation processes and products (Nambisan et al. 2017, 2019). However, few studies describe how the DT journey can create value for SMEs related to digital innovation. In addition, we argue that SMEs need to allocate their resources to innovation and DT projects with a better chance of success. And, the potential benefits are achievable in the short term, allowing them to optimize these resources and strive for successful innovation initiatives and value creation, especially in a COVID-19 context.

This gap requires attention since SMEs have a smaller margin of error due to their more limited resources (Astrini et al. 2020). In this context, our research objective is to understand how SMEs that have successfully innovated during the recent health crisis have evolved technologically and how DT has enabled value creation. Our research question is: what are the benefits of DT in SMEs that successfully innovate in a COVID-19 context?

The contributions of this research help understand how certain SMEs conducted innovation initiatives to survive crises by creating new products, reinforcing links

between DT and digital innovation. Finally, the acceleration of DT initiatives has enabled digital innovation as products, processes, and managerial innovation for SMEs. Our research also contributes to applying the theoretical S⁴ DT framework (Bordeleau et al. 2021) to the analysis of these SMEs' respective journeys. We concluded that technologies worked as triggers that required new capabilities and skills to carry out transformation and innovation in value creation for customers, stakeholders, and society in the COVID-19 context.

2 Theoretical Background

2.1 Innovation and Digital Innovation

Innovation is defined in academic and professional literature, highlighting the innovation process or outcomes. The Oslo Manual (2018) presents two major types of innovation: innovations that change the firm's products (product innovations) and innovations that change the firm's business processes (business process innovations). A product innovation "is a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced on the market" (OECD 2018, p. 21). A new product (goods or services) can require business process innovation. It is defined as a "new or improved business process for one or more business functions that differ significantly from the firm's previous business processes and that has been brought into use by the firm" (OECD 2018, p. 21).

Digitalization can "entail the application of digital technologies to a wide range of existing tasks and enables new tasks to be performed" and "has the potential to transform business processes" (OECD 2018, p. 37). Digital innovation refers to the "use of digital technology during the process of innovating" (Nambisan et al. 2017, p. 223) and "the creation of (and consequent change in) market offerings, business processes, or models that result from the use of digital technology" (Nambisan et al. 2017, p. 224).

Digital innovation and DT are two related concepts because they require changes in business processes and lead to value creation using emerging technologies. Emerging technologies can be digital, physical, and biological technologies that are ubiquitous in our daily lives as well as in organizations, leading to a robust technological convergence that should change the modus operandi of all productive sectors in an unprecedented way (Schwab 2016). As mentioned by Nambisan et al. (2017), the properties of digital technologies offer new opportunities for creating infrastructure, products, and business models and, thus, can reshape the ways in which firms organize for innovation (Nambisan et al. 2017) with what is known as DT. DT changes the nature and structure of new products and services, creates novel value creation, and transforms industries propelled by emerging technologies.

2.2 *Digital Transformation*

DT is crucial for businesses, and it is gaining attention worldwide. Digital technologies do not create value per se, but it is their use in a particular context that allows organizations to discover novel ways to create value in a new and constantly changing environment; technologies are the spark enabling DT (Bordeleau et al. 2021; Wessel et al. 2021). Technology is one piece of the complex puzzle in an organizational context since creating value requires rethinking the strategy, structure, and processes that call for mindset and cultural changes within the organization (Vial 2019). Otherwise, DT could amplify the gaps in the organization and make them visible, generate employee disengagement, and more (Tabrizi et al. 2019). Managers and researchers are still struggling to conceptualize both the DT journey and its end goal for value creation. DT is complex to manage in a real setting, and the need to understand how to support businesses in their transformation remains (Bordeleau et al. 2021).

Business managers and senior executives have pointed out that DT is a concern because 70% of DT initiatives do not reach their goals (Tabrizi et al. 2019). DT has both intended and unintended opportunities and challenges that emerge in different levels and contexts since it is related to social and technical shifts in organizational contexts (Bordeleau et al. 2021). Socio-technical system theory considers human and technological and organizational issues in technology deployment (Bostrom and Heinen 1977).

The “S⁴” integrated framework of DT presents an interdependent vision of socio-technical elements for value creation (Bordeleau et al. 2021). The authors have presented a DT journey that stems from a technology-push perspective to help people to understand this complex phenomenon. It begins with technology convergence or triggers, and its building blocks consist of capabilities (human, organizational and technological) and innovations around value. This journey results in a meaningful understanding of DT for future organizations (Bordeleau et al. 2021).

2.3 *DT S⁴ Framework*

The S⁴ framework proposes that emerging technologies from the digital (e.g., artificial intelligence or cloud computing), physical (e.g., advanced materials), and biological (e.g., advanced genetics) worlds are the triggers for digital transformation, especially through their potential to converge into sophisticated systems (e.g., 3D printing of human tissue). These triggers need capabilities or skills, such as the ability to work in real-time, among others. These capabilities are organized into three groups: human capabilities (e.g., humans have enhanced visualization capabilities with the use of augmented reality), technological (e.g., data processing will be much faster with quantum computing), and organizational (e.g., organizations can have a direct channel with almost all customers through social media). Furthermore, these

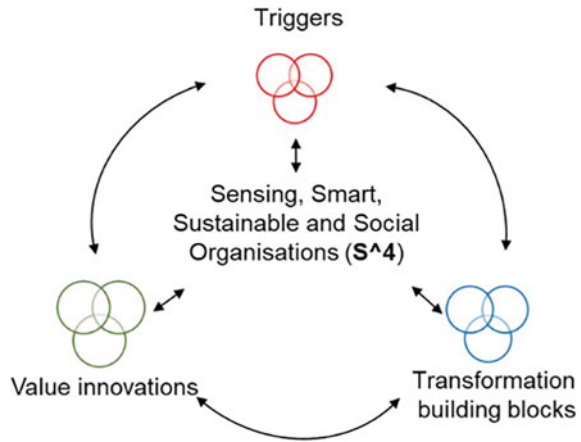
capabilities can be combined and enable value creation differently, driving innovation (Bordeleau et al. 2021).

The capabilities supported by DT principles are building blocks that are essential to the proposition, creation, delivery, and management of value. According to Bordeleau et al. (2021), the notion of value takes a central place in the DT journey. Three types of innovation around value are proposed: the notion of value may be different (e.g., the value of a smartwatch goes beyond providing the time), the way value is created and distributed may be different (e.g., the production of super-customized parts through additive manufacturing and drone delivery), and finally the way the value creation chain is managed may be different (e.g., a supply chain in a 3D printing platform, such as 3DHubs or Thingiverse, may include thousands of suppliers, instead of hundreds, forcing managers to rethink how to develop and evaluate suppliers). Together or separately, these three types of innovation around value have the potential to create the next-generation enterprise which undertakes DT with a broader ambition than just being technology-oriented.

Innovations around value allow a business to become more “sensing,” as it can better sense or understand its internal and external environment, thanks to the enormous amount of data available. Using available data analyzed with artificial intelligence algorithms (e.g., deep learning) makes businesses smarter since the quality of decisions is better. Moreover, companies can be more sustainable in these actions since their decisions are more data-driven and holistically analyzed. Finally, businesses have the chance to propel the adaptation and evolution of the social beings that we are, i.e., supporting collective intelligence and cooperation (“social”). Businesses, humans, and objects, e.g., the Internet of Things, are connected now like never before (Bordeleau et al. 2021). Then, the four main aspects (triggers, ingredients/principles, innovations, and intentions) interact cyclically to guide the DT journeys of organizations, leading to greater intended impact as well as to a better awareness of their impact at different levels, including organizational and societal. By doing so, businesses have the opportunity to become more intended-impact and conscious organizations. The value creation for these businesses is limited to business performance in terms of financial and productivity indicators, but it is created for the business ecosystem (Bordeleau et al. 2021). The authors mention that “sensing”, smart, sustainable, and social business enables business and mindset intentions for the transformation of the following generation of organizations, called “S⁴” organizations. The integrative S⁴ framework is shown in Fig. 1.

All these considerations are important for SMEs because they are known to have less resources than large enterprises to innovate and integrate the latest technology (Blais 2023) nor unlimited access to information on the most up-to-date technology (Hassani and Mosconi 2022). This can explain why some SMEs are slow to invest in new technology and struggle to rethink their value creation by redefining strategic, structural, process-based, and cultural aspects of the business (Wessel et al. 2021). SMEs are more likely to improve their readiness and their capability to innovate successfully, using digital innovation as a lever for value creation. The S⁴ framework proposes a vision for a DT journey for value creation that we will adopt to analyze the journey of SMEs during the COVID-19 pandemic.

Fig. 1 S⁴ Framework for the DT journey—adapted from Bordeleau et al. (2021)



3 Research Methodology

DT and its value creation on SMEs as well as digital innovation are topics currently underdeveloped in the literature in terms of case and field studies. Then, exploratory research through a multiple case study approach seems appropriate to investigate this phenomenon in SMEs (Yin 2017).

3.1 Case Selection and Description of SMEs and Respondents

Two Canadian SMEs were selected (SME A and SME B1) because the recent COVID-19 pandemic led them to adopt an innovation strategy based on emerging technologies. These two SMEs were known to the researchers from a previous collaboration. A new set of data was collected during the global pandemic, providing an in-depth and longitudinal understanding (2019–2020) of their innovation practices and DT strategy.

These SMEs are the only enterprises in a previous sample of five enterprises to have innovated and implemented technologies during the pandemic. Not all SMEs had the same leadership in innovation in this period, so it becomes essential to focus on those that stood out and to learn more about their innovation strategy and innovative practices.

The two SMEs innovated by developing protective equipment to ensure the safety of thousands of employees in the agri-food (SME A) and health (SME B) sectors. They have been widely cited in the media for their innovative capacity and success during this period. Considered “nonessential” businesses at the beginning of the

Table 1 Information about the SMEs and characteristics of respondents

| | Number of employees | Sales (Canadian \$) | Position within the SME | Education | Years of experience in innovation |
|-------|---------------------|---------------------|-------------------------------|------------------------|-----------------------------------|
| SME A | 85 | 14 million | CEO and owner | MBA | 28 |
| | | | R&D Director | Engineer | 15 |
| SME B | 265 | 40 million | VP Operations and Engineering | Plastic technician | 6 |
| | | | Business Development Director | Engineering technician | 2 |

pandemic lockout, these SMEs temporarily ceased their activities following the policies imposed by the Canadian government. Table 1 presents information about the SMEs and certain characteristics of their respondents.

3.2 Data Collection and Analysis

Once an agreement was reached on the respondents' participation, the data collection consisted of a 90-min semi-structured interview with two managers in each SME. Other data sources were also analyzed: internal reports, the companies' websites, and social and traditional media featuring their activities. The use of multiple sources increases the quality of data collected and allows triangulation (Yin 2017).

The data were then transcribed, classified, and coded under different previously identified themes as well as new themes that emerged during the analysis using NVivo software. The principles of thematic analysis were applied (Paillé and Mucchielli 2008). The themes used to code the data include technology implementation projects (triggers), resources and skills (capabilities—building blocks), innovation initiatives, and DT benefits and challenges for future development.

4 Results

During the recent pandemic, the two SMEs identified an opportunity to rethink their business value proposition by innovating and integrating digital technologies. This period allowed SME managers to step back and think about how to develop and market their new products adequately. We found that the low level of technological implementation before the pandemic was, at least in part, improved and compensated for during the pandemic. These initiatives enabled SMEs to meet their need to reach the market quickly. It also allowed both SMEs to reemploy most of their staff to

produce their protective equipment during a difficult moment of the pandemic supply chain disruption.

We adopt the S⁴ framework to understand and analyze the data collected on the DT journey of the SMEs studied. SME A and SME B experimented with digital innovation and DT at the same time since their managers decided to innovate by integrating a new product into the market. We use the S⁴ to study their implemented technologies (digital, physical, and biological—triggers of DT); the explored and exploited as capabilities (building blocks); the innovation outcomes (product/service, processes or managerial) and what they get from this journey in terms of benefits and challenges. Finally, our aim was to study how these benefits and challenges could be related to becoming an intelligent organization, an organization of the new generation, which is S⁴ or an intelligent organization (sensing, smart, sustainable, and social).

4.1 Technology Implementation Projects (Triggers)

During the recent pandemic, the two SMEs conducted technology implementation projects to meet their needs and quickly meet the market to face supply chain disruption and business opportunities. We found that the low level of technological implementation before the pandemic was, at least in part, improved and compensated for during the pandemic. This period accelerated the implementation of technology initiatives. To illustrate this acceleration,

In the past, we had discussions about 3D printing: are we investing in it? We didn't see the possibilities. However, the need to manufacture certain components in-house to deal with the inability to purchase them externally [during the pandemic] led to the purchase of 3D printers. So overnight, the first deal I did, was to order a 3D printer. We started developing [the new product], learning about 3D printing and how it works. But not long after that, we bought a second [3D] printer. Then not long after, we bought a third [3D] printer with a different technology [VP Operations and Engineering—SME B].

Table 2 shows the technology implementation projects (digital and physical technologies) conducted before and during the pandemic in each of the SMEs.

Like many enterprises, before the health crisis, both SMEs were connected to the Internet and used cloud computing to host data, advanced software, and an ERP system. Teleworking was already present. The use of these technologies allowed access to enterprise data everywhere and facilitated distance working. However, SME B differs from SME A by implementing more pre-pandemic technology initiatives. The automotive field of SME B explains in part its greater technological advancement because it had to invest more to meet the needs of major clients of the industry. SME B is known for its avant-gardism in terms of robotization and automation of its production line on several sites, including a plant in Mexico. SME B has camera-based control systems (with sensor and distance control) to monitor the quality of the products manufactured, allowing it to react more quickly if a defect occurs. Better quality control and more stability in production are then noted. All of SME

Table 2 Technology implemented in SMEs before and during the pandemic

| Technologies implemented | SME A | | SME B | |
|---------------------------------|--------|--------|--------|--------|
| | Before | During | Before | During |
| <i>Digital</i> | | | | |
| Advanced software | x | x | x | x |
| Automation of tasks (paperless) | | x | | x |
| Cloud computing | x | x | x | x |
| Connected sites (plants) | | | x | x |
| Distance control | | | x | x |
| Integrated system/ERP | x | x | x | x |
| Internet connection | x | x | x | x |
| Internet of things | | x | x | x |
| Sensor | | x | x | x |
| Technology platform—e-commerce | | x | | x |
| Teleworking | x | x | x | x |
| <i>Physical</i> | | | | |
| 3D printing | | | | x |
| Robotic—automation | | x | x | x |

B’s factories are connected to the same information systems, and key performance indicators (KPI) are output in real-time from the production sites.

4.2 Resources Used to Deploy These Initiatives (Capabilities—Building Blocks)

The availability of a recently hired marketing resource has helped SME A deploy a transactional platform. As mentioned by the CEO: “We are developing marketing tools because we now have a full-time marketing resource. We are creating a transactional platform and technological tools to support sales. We are also more active on social media [because of this staff]”.

By integrating a transactional platform, SME A needed to invest in technical capabilities to support the connectivity and the dematerialization of the sales business process. This decision is a digitization decision that helped it to respond to business needs to improve sales and business performance.

For SME B, the availability of an in-house resource skilled in IT helped in the deployment of all digital initiatives. The VP Operations and Engineering mentions that “We are fortunate to have someone in IT who is forward thinking and believes in it, so initiatives are often put in place ahead of time [compared to other enterprises in the sector].”

4.3 *Innovation Initiatives*

To survive and seize an opportunity in a new market, SME A and SME B conducted innovation initiatives that allowed them both to develop innovative products. The lockdown and the ceased activities allowed them to take the available time to figure out how to innovate and restart their activities. They identified an opportunity to rethink their business value proposition by innovating and integrating digital technologies, which gave them several benefits and brought challenges but also opened their eyes to future developments.

4.4 *Digital Transformation Benefits*

During the pandemic, both SMEs innovated and implemented new technologies (Table 2) to satisfy multiple requirements in their innovation process for developing their new products. However, these initiatives differed from each other, as their needs were also divergent, even if their new products were, in both cases, a piece of protective equipment.

SME A identified technologies and acquired new digital production equipment promoting the automation of the cutting function (with sensors) and established a transactional website (e-commerce). The digital production equipment allowed:

- to improve production capacity by reintegrating operations previously done by subcontractors,
- to manage client demand by better-controlling production,
- to reduce product development and commercialization time by making more prototypes in less time,
- to reallocate its workforce to more profitable products,
- to obtain real-time data to support decision-making,
- to increase productivity and operations effectiveness,
- to raise the quality level of the developed product, and
- to increase control over costs, deadlines, and quality.
- The transactional website benefits were meeting clients' needs within three days, and
- increasing sales for products already in inventory.

For SME B, the need to manufacture specific components internally led to the purchase of three 3D printers. This investment brought some benefits:

- solving technical problems more quickly,
- providing better guidance on corrections to be made before the “real” component became available,
- offering greater flexibility,
- accelerating product development,
- facilitating iterations during product development,

- having more possibilities to validate certain mechanical concepts,
- better managing technical risks, and
- generating innovation in the processes that were beneficial to the manufacturing of other products.

Other technology implementation projects included the creation of a transactional website (e-commerce), integration with customer systems, and the implementation of an Amazon Store. These initiatives allowed SME B to:

- meet the requirements for doing business with clients, and
- generate sales faster.

The integration of these technologies required improvements in technical, human, and organizational capabilities to reach innovation on the product and on the process and culminated in DT's impact on the value proposition of the SME.

4.5 Challenges for Future Technology Development

The implementation of digital technologies has led managers of both SMEs to focus more on this aspect for the future development of their enterprise. Managers are wondering about artificial intelligence. The challenges (or unknowns) regarding the possibilities of implementing new technology relate to two main aspects:

- the approach to integrating this technology:
- “I don’t know exactly how to get there” [R&D Director—SME A]
- the balance of effort to ensure that the desired results are achieved by implementing this technology:
- “We started hearing the word (artificial intelligence). It brought us a certain level of curiosity. I read a lot about it, and I ask myself, what can we do with it? What are we going to get in terms of contracts with clients? What are we going to put effort into? We have limited resources with engineering. We are very few people. At the end of the day, it’s about knowing, the time we put in. Does it pay off?” [VP Operations and Engineering—SME B].

5 Discussions

The objective of this paper is to understand how SMEs that have successfully innovated during the COVID-19 pandemic have evolved through DT and how it leveraged value creation. Case studies were conducted in five SMEs to learn more about the topic. However, only two corresponded to the research criteria: successfully innovating at the product, process, and managerial levels by using emerging technologies during the recent pandemic. We observed that during the COVID-19 pandemic, some

SMEs decided to innovate by introducing new products in a new market and implementing new technology initiatives to help them achieve their innovation project. However, during this period, uncertainty was high because many enterprises had to shut down their activities, the supply chain was disrupted, and the usual way of doing things was no longer useful. It was, therefore, necessary to integrate new ways of doing things (Cukier et al. 2021).

The two SMEs invested in technology initiatives to compensate for the lack of internal resources and for the inability of external suppliers to adequately meet their needs in a changing environment. These innovation initiatives were mainly associated with digital and physical triggers and helped SMEs accelerate technology integration in their activities and processes. This accelerated digitization and DT allowed them to counterbalance the slow and late adoption of technologies and implementation of technological projects. It also contributed to generating product innovation more efficiently and launching new products faster, thus reducing the potential loss of resources. These decisions were crucial in helping SMEs achieve success in innovation initiatives during the pandemic and in reducing the potential risk of failure in projects. In the context of SMEs, because they are known to have more limited access to resources than larger enterprises, it is essential to identify possibilities that can help use the resources efficiently.

As DT goes beyond technological aspects (Bordeleau et al. 2021), the technology initiatives implemented need to create value for the business to make the DT journey useful. The two SMEs in our study used the pandemic context to rethink their business model and to invest in innovation initiatives with the integration of new technologies. By using internal capabilities to exploit these technologies, they were able to transform their value proposition (product innovation), their business process (process innovation), and their relationship with partners in the supply chain (managerial innovation).

Following the S⁴ DT framework, we observed that SME A and B's journeys required improvements of their building blocks based on technical, human, and organizational capabilities to innovate in their products, services, and processes, culminating in DT impacts on their respective value proposition (Bordeleau et al. 2021). The technology implementation projects and the innovation initiatives led to changes in business practices and strategies and encouraged the SMEs to review their business processes and their innovation and digital strategy.

6 Theoretical and Practical Contributions

The contributions of this research help understand how SMEs conducted innovation initiatives to survive COVID-19 pandemic challenges by creating new products. Also, in the two cases under study, DT accelerated and enabled new products and processes since technologies worked as triggers that required new capacities and generated innovation around value creation for customers and other stakeholders, and society in the COVID-19 pandemic context.

As theoretical contributions, we clarify the value created by digital technology initiatives undertaken by two SMEs that innovated in a COVID-19 context. The innovation leveraged by these SMEs' DT journey provides a meaningful understanding of how these decisions were beneficial and how they became resilient and improved their readiness for the next generation of business.

In summary, we propose that DT and digital innovation in SMEs are deeply linked. Digital innovation is generated by an innovation initiative: most innovation projects use emerging technologies (triggers) that are currently integrated into products, processes, and managerial practices that create digital innovation; that is sparks for DT.

DT is also guided by innovation initiatives: most redefinitions of business lead to digital innovation as an integrated outcome of the journey based on the convergence of emerging technologies explored and exploited by organizational, technical, and human capabilities in organizations. They are interrelated and interdependent. Our study observed that both DT and digitization are founded on the building blocks of transformation, as suggested by Wessel et al. (2021), and that they also contribute to catalyzing digital innovation.

For the practical implication, our results show that the DT journey is difficult to navigate for SME managers, who are not always able to perceive and anticipate its impacts and challenges. All businesses, including SMEs, are experiencing paradoxical choices. On the one hand, with difficulties and challenges related to digitalization, disruption of the supply chain, and rapid changes in customer needs, companies need to improve their processes and think about how they need to change to remain competitive. At the same time, they must invest in DT initiatives even as they struggle to capture the full potential of their transformation efforts or deliver a satisfactory return on investment (Bordeleau et al. 2020; McKinsey 2022).

On the other hand, our results showed that the DT journey generates digital innovation that creates opportunities and advantages for SMEs, all while generating huge amounts of data. These advances will require new innovations to deploy artificial intelligence to benefit from the data available, pushing businesses to invest in skilled people and new organizational capabilities to absorb this new game changer across many industries (Gröger 2021). By understanding this dynamic, we recommend practitioners and managers embark on continuous innovation. Therefore, our study's conclusions can motivate managers to implement digital technology initiatives like those undertaken by the participating SMEs because they may better understand their potential benefits and increase the organization's resilience.

7 Conclusion, Limitations, and Future Research

Our research objective led us to document product-related, process-related, and management-related innovations as well as the technology implementation projects that culminated in a DT journey. We also observed their benefits and challenges to

better understand the value creation of innovation initiatives in two SMEs during a pandemic.

The COVID-19 pandemic challenges led these SMEs to rethink their business model by investing in new technologies that helped them innovate faster and in a way that used their limited resources more efficiently (Clauss et al. 2022). The two SMEs had to compensate quickly for the changes in the environment: almost every business was closed, disrupting the supply of components, even internationally (Baig et al. 2020; Wenzel et al. 2021). These SMEs innovated in a hurry to survive in this context but also to be in a better position (new market, new customers) after the pandemic. The accelerated technology implementation projects allowed them to counterbalance the low technological maturity level they had before the pandemic (Baig et al. 2020; Cukier et al. 2021). The technology implementation benefits of these initiatives create short-term value in these SMEs and hopefully for a longer period since businesses have had no choice but to embrace emerging technologies, new capabilities and skills and value innovation to become more sensing, smart, sustainable, and social (Bordeleau et al. 2021). Doing so will help them to face significant challenges and develop opportunities linking DT and digital innovation, with no regard to the activity sector or business size.

Our study was conducted on only two SMEs, and the conclusions cannot be generalized to the broader SME population. The exploratory nature of our research helps to better understand the impacts and benefits of a DT journey. Conducting the study in other contexts and with other SMEs (that experienced failure instead of success in innovation, for example) could have led to other conclusions. For future research, it may be interesting to document the benefits of emerging technologies such as artificial intelligence, for example, implemented in SMEs as a spark for digital innovation. It could also be interesting to follow a DT journey in a longitudinal study to better identify trigger mechanisms, such as emerging technologies, to document the challenges, failures, and benefits related to digital innovation. In this paper, there was little discussion of how a DT journey can be helpful for businesses of the following generation, as suggested by the DT S⁴ framework. Further research could explore the contribution of innovation around value to become more sensing, smart, sustainable, and social. Finally, DT appears to be necessary for today's companies, including SMEs that wish to innovate, stand out and survive in the current business context.

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