How can SMEs successfully navigate VUCA environment: the role of agility in the digital transformation era

Abstract
Organizational agility, that is the ability to anticipate or respond quickly to external changes, is essential to survive and compete in today's turbulent landscape, characterized by technological advancements and digitalization. Research on capabilities that enable firms to be agile in the so called VUCA environments, is still nascent. Hence, it is important to explore the antecedents of firm agility and to identify the factors enabling them to better compete. Even more so in the case of SMEs, as they are more vulnerable in hypercompetitive business environments and at the same time agility has been less studied in this context. Focusing on SMEs, the study investigates three antecedents of agility, namely digital technologies capability, relational capability and innovation capability, and the effects of agility on three outcomes, namely financial performance, product, and process innovation. Our findings indicate that these capabilities contribute to build organizational agility in SMEs and that, in turn, agility has a positive impact on performance, thus confirming that agility contributes to the success of SMEs and that digital technologies play a central role in this process. Thus, it is of strategic importance for SMEs to increase their efforts to develop these capabilities to build enduring businesses. They should nurture a relational and innovative culture, as well as transform their business culture starting from digital technologies.

Keywords: agility; digitalization; digital transformation; innovation capability; digital technologies; performance

1. Introduction

Contemporary organizations face environments with unprecedented levels of volatility, uncertainty, complexity, and ambiguity (VUCA), a context that scholars have defined as a 'VUCA world' (Bennett and Lemoine, 2014; Millar et al., 2018). Managing in these scenarios require different strategies for large companies and small and medium-sized enterprises (SMEs), since the latter cannot count on the robustness deriving from abundant material and financial resources (Brink, 2018). Organizational agility, arguably, is the key strategy to counter the challenge of VUCA for both large companies (Bennett and Lemoine, 2014: 314) and SMEs (Roberts and Grover, 2012). Digital technologies potentially improve organizational agility, enabling better adaption to changing external conditions (Bodwell and Chermack, 2010; Martínez-Climent et al., 2019; Trost, 2019; Vecchiato, 2015).
Indeed, surviving and successfully competing in the 'VUCA world' requires the ability to anticipate or respond quickly and effectively to external changes (Lu and Ramamurthy, 2011; Ravichandran, 2018; Teece et al., 2016) especially in today's competitive landscape characterized by technological advancements and digitalization (Bresciani et al., 2021a, 2021b; Kohtamäki et al., 2020; Youssef et al., 2021; Yuan et al., 2021). According to Lu and Ramamurthy (2011: 932) "Organizational agility is a firm's ability to cope with rapid, relentless, and uncertain changes and thrive in a competitive environment of continually and unpredictably changing opportunities". Agility is a key ability for firms to compete (Chan et al., 2019; Ravichandran, 2018). Sambamurthy et al. (2003: 237) argued that "Agility is vital to the innovation and competitive performance of firms", while Škare and Soriano (2021) pointed out that firm agility is a survival instrument in today's turbulent environment. Organizational agility influences firm performance and enhances competitiveness

(Crocitto and Youssef, 2003; Rialti et al., 2019; Tallon and Pinsonneault, 2011). It can be seen as an 'ongoing process' where firms need to develop new capabilities to become increasingly agile (Holbeche, 2018; Kane et al., 2015; Linstone and Phillips, 2013; Phillips and Linstone, 2016).

As argued by Holbeche (2018: 1), agility is not a 'stand-alone capability', but a set of capabilities. Hence, it is important to explore its antecedents. Previous studies that focused on antecedents of organizational agility underlined the need for further research (Ghasemaghaei et al., 2017; Lu and Ramamurthy, 2011; Ravichandran, 2018). Ravichandran (2018: 22) pointed out that "research on the resources and capabilities that enable firms to be agile is still nascent". In this respect, a promising avenue of research is the study of the impact of digital technologies on organizational agility (Ravichandran, 2018). Besides enhancing firm performance (Ferraris et al., 2018), digital technologies improve the agility of organizations; however, the empirical evidence is mixed (Li et al., 2021; Shams et al., 2021).

Leaving aside the ambiguity of empirical results, there is a dearth of systematic empirical research where SMEs provide the context (Chan et al., 2019; Scuotto et al., 2017). As argued by Chan et al. (2019: 439) "Compared with large organizations, SMEs are typically less formal, lean, and flatter in terms of their organizational structure" and, moreover, "SMEs are also often hindered by resource limitations and are thus more vulnerable in a hypercompetitive business environment in which disruptive changes abound" (Chan et al., 2019: 437). SMEs struggle to respond to changes in business environment (Fourné et al., 2014; Neirotti and Raguseo, 2017). The extant literature suggests that SMEs often rely on the creativity and innovativeness of their employees to compensate for the lack of financial resources (Cucculelli and Bettinelli, 2015; De Martino and Magnotti, 2018). Another lever to increase their competitiveness is the network of external relations they build, which guarantees access to external resources (Jørgensen et al., 2010). Recourse to structural, capital intensive assets instead is less common. Furthermore, the use of complex information systems is often not feasible or even counterproductive for SMEs (Hervas-Oliver et al., 2021). Current digital technologies (Bresciani et al., 2018) seem to have a higher level of flexibility and accessibility which could make them useful tools for small and medium sized businesses (Goswami and Kumar, 2018; Škare and Soriano, 2021). Hence, the need to explore factors that allow SMEs to become agile enabling them to better compete in VUCA environments (Shin et al., 2015).

Although SMEs increasingly use digital technologies to enhance the impact on internationalization, productivity and performance (Cassetta et al., 2020; Papadopoulos et al., 2020), little is known about the effects of their digital technologies capability on organizational agility. We propose that these capabilities, as well as innovation capability, sometimes also indicated as innovation capacity (Ravichandran, 2018), could play a key role in affecting organizational agility.

The aim of this paper is to contribute to the current debate on the antecedents of organizational agility in SMEs and on the effects of agility on their performance. In doing this, our research focuses on three specific types of antecedents, namely digital technologies capability, relational capability and innovation capability, and on three different outcomes, namely financial performance, product, and process innovation. There is a paucity of empirical studies that provide evidence on the relationships between these capabilities and agility, in particular in the context of SMEs, and examine the ultimate effects of agility on these outcomes.

This paper makes two important contributions. First, based on a thorough literature review of the concept, our work contributes to the literature by proposing a model including innovation capability and both digital technologies and relational capabilities as organizational factors behind organizational agility. Second, whereas most prior research on organizational agility has focused on large companies, our study tests the theoretical model in the under-investigated case of SMEs. Our research highlights that innovation capability and both digital technologies and relational capabilities help firms to build organizational agility and that, in turn, agility has a positive impact on financial and innovation (in terms of product and process) performance, thus confirming that

agility contributes to the success of SMEs and that digital technologies play a central role in this process.
The remainder of this paper is structured as follows. First, we present a review of the relevant literature in Section 2. Section 3 focuses on hypotheses development, followed by the research methodology and the main results of the study. The last two sections conclude by discussing the findings, the implications of the research and the limitations as well as directions for future research.

2. Literature review

In this section, after having clarified the meaning of organizational agility (OA) for the purposes of this study, we will proceed to present a summary of the literature on its impact on performance, the application of the concept in the context of SMEs and its antecedents, with particular reference to technology and, specifically, to digital technologies.
The literature provides several definitions for organizational agility, however there is a general consensus among scholars that it concerns a firm's ability to respond to the challenges posed by the changing and uncertain environment and to renew its business (Tallon and Pinsonneault, 2011; Teece et al., 2016; Zain et al., 2005). OA depends on the ability to manage relations with customers, business processes, as well as relations with other partners (Lu and Ramamurthy, 2011; Roberts and Grover, 2012; Sambamurthy et al., 2003; Tallon and Pinsonneault, 2011).
OA requires the organization to develop flexibility at both the operational and strategic level (Haider et al., 2021). In the case of operational agility, the main emphasis is on process flexibility (Tan et al., 2017), while in the case of strategic agility the importance of reformulating the company's offer to align with the changing needs of the reference market is emphasized. For example, Huang et al. (2012) define *operational agility* as the ability of firms' business processes to achieve speed, accuracy, and cost economy in the exploitation of opportunities for innovation and competitive action. Weber and Tarba (2014) instead, define *strategic agility* as the ability to remain flexible in facing new developments, to continuously adjust the company's strategic direction, and to develop innovative ways to create value. Both components of agility are considered fundamental to quickly grasp environmental opportunities, adapt to change, and ultimately achieve OA (Ahmmad et al., 2020).
The extant literature suggests that agility helps firms to gain a better position in the market – in fact, they disclose a better equipment to respond to technical/market changes – and to grow their profits (Alegre and Sard, 2015; Chen et al., 2014; Ravichandran, 2018; Sambamurthy et al., 2003; Tallon and Pinsonneault, 2011; Van Oosterhout et al., 2006). Some studies show that agility is associated with superior firm performance (Ravichandran, 2018), organizational performance and higher likelihood of surviving challenges of VUCA world (Rialti et al., 2019). Using data from an international panel of SMEs, Demir and colleagues (2021) found that strategic agility has a strong positive impact on internationalization initiatives, both from the point of view of internationalization speed and internationalization success.
In particular, organizational agility has been associated with improved financial performance in SMEs: the ability to quickly seize opportunities gives agile companies, in particular small and medium-sized enterprises, a first mover advantage that allows higher returns (Liu and Yang, 2019; 2020). Existing evidence proves the importance of OA both in its operational component, in order to adapt to local variations in the business context (Gligor et al., 2019), and in its strategic component, in order to recognize and rapidly satisfy new customer needs (Zhou et al., 2019).
OA is also tightly linked to innovation performance. New ideas are more easily implemented into business initiatives in agile organizations (Pellizzoni et al., 2019). Besides, by facilitating adaptation to new markets and technologies, agility facilitates success of new products, processes and business models (Brand et al., 2021; Kohtamaki et al., 2020).

Among these studies, some included financial performance among the outcomes of organizational agility (e.g. Ravichandran, 2018), while innovation performance are little explored in this context although a number of studies in literature stressed the importance of considering this outcome and the existence of a positive relationship between the use of specific ICTs and SMEs' innovation performance (Fernández-Mesa et al., 2014; Joshi et al., 2010; Scuotto et al., 2017).

While a large part of the literature on OA focuses on large firms, some studies have found it to be of importance also for the success of SMEs (Benzidia and Makaoui, 2020; Khan et al., 2020; Naughton et al., 2020). OA is the result of capabilities at an operational level, in particular relating to the management of supply relationships (Naughton et al., 2020) and capabilities at a strategic level, connected with understanding the evolution of the market (Khan et al., 2020).

Lu and Ramamurthy (2011) showed that IT capability positively influences organizational agility. These scholars framed organizational agility through two dimensions, namely market capitalizing agility and operational adjustment agility. In addition, other authors found that firms need to develop high IT capabilities in order to build agility. Ghasemaghaei et al. (2017) focused on a specific IT capability, namely the use of data analytics, and highlighted that it improves firm's agility. Similarly, prior studies showed that IT capability has a positive effect on firm's agility (Roberts and Grover, 2012; Tallon, 2008), however findings are mixed (Ray et al., 2005) and, in fact, some scholars found that it does not increase firm agility (Liu et al., 2013; Swafford et al., 2008).

The study of Ravichandran (2018: 22) showed that "firms with superior information systems capabilities coupled with an aggressive IT investment orientation create digital platforms that enable them to be agile".

Recently, Shams et al. (2021) designed a specific framework to highlight the key conditions for firms to achieve both agility and international success. The scholars underlined the importance of focusing on three factors associated with agility, namely IT agility, supply chain agility, and agile and sustainable productions.

Digital technologies are the application of software technologies to existing business practices to transform them or, in certain cases, to create entirely new processes. An important feature of digital technologies is their pervasiveness and accessibility which make them an opportunity for all organizations (Akhtar et al., 2018; Pergelova et al., 2019).

Studies linking digitalization and agility are few and assume different points of view. From one perspective, some studies suggested that digitalization promotes firm agility (Li et al., 2021; Lucas and Goh, 2009) and thus mitigate potential risks related to rigidity and reduce the consequent failures (Shams et al., 2021). By contrast, several scholars focused on the importance of organizational capabilities for companies as drivers for creating value and capitalizing on digital technologies (Akhtar et al., 2018; Chan et al., 2019; Jagtap and Duong, 2019; Kane et al., 2015).

A recent study by Škare and Soriano (2021) provided evidence on the essentiality and robustness of the relationships between the national/industry level of digitalization and firm agility.

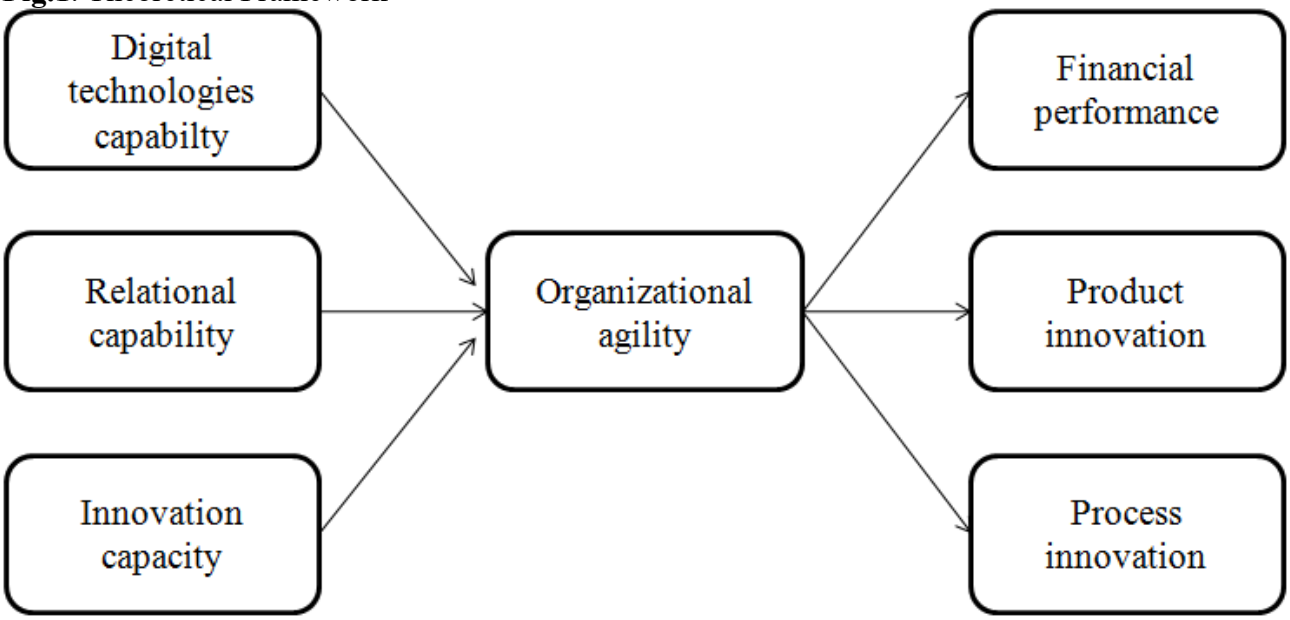
As pointed out by Li et al. (2021: 700) "Firms are increasingly transforming themselves into agile enterprise by integrating and exploiting digital technologies" and the scholars found that these companies enhance "their ability to respond to environmental turbulence in the markets promptly".

The current literature lacks studies on the role of digital technologies in fostering organizational agility.

In particular, studies on the relationship between digital technologies and OA are rare in the context of SMEs (Naughton et al., 2020). Existing studies suggest that the way SMEs manage information technology (IT) affects both supply chain agility and market agility (Benzidia and Makaoui, 2020; Jermsittiparsert and Wajeetongratana, 2019). The mediating role of organizational agility is considered one of the key mechanisms through which digital technologies impact on SMEs performance (Qosasi et al., 2019; Ravichandran, 2018; Rozak et al., 2021). Digital technologies have the potential to transform both organizational structures and the business making culture of SMEs, and ultimately foster their process of digital transformation (Ulas, 2019). Existing evidence,

however, is limited to qualitative studies and/or specific sectors (e.g. Qosasi et al., 2019), while there is a lack of quantitative studies that focus on the impact that digital technologies have on the agility of SMEs in general.
Similarly, the role of relational capability has not been extensively investigated in relation to organizational agility. The few existing studies show contrasting results. For example, Naughton et al. (2020) have found that supply chain relationships support agility. Liu and Yang (2020) underline how networking increases market intelligence capabilities of SMEs and, consequently, agility. Jamal et al. (2019), however, have found that the two variables are independent and both outcomes of supply chain flexibility.
Hence, this study aims to increase understanding on these two antecedents of organizational agility: digital technologies and relational capability. At the same time, we aim to explore the importance of innovation capability (see among others Ravichandran, 2018).
Based on the above, we propose a theoretical framework focused on three antecedents of OA and three outcomes. The following figure 1 depicts the research model tested in the study.

Fig.1. Theoretical Framework



3. Hypotheses

Figure 1 depicts our research model. The model proposes that antecedents of SMEs agility are threefold. First, digital technologies, considered both in terms of the availability of technologies and in terms of the flexibility of the overall technological infrastructure. Second, relational capability, understood as the ability to create and maintain relationships with key players. Third, the capability for innovation, understood as jointly determined by the innovation of the company and the level of coupling of innovation with business activities. The model also suggests a direct relationship between SMEs agility and their performance, both understood as financial performance and as product and process innovation.

3.1 Digital technologies capability and organizational agility in SMEs

As mentioned earlier, digital technologies affect performance only in association with agile organizational capabilities (Akhtar et al., 2018). The nature of this association, however, is not clear. While most of the studies advocate that digitalization promotes agility (Li et al., 2021; Shams et al., 2021) others have found the relation to be exactly the opposite with agility being an antecedent for the adoption of digital technologies (Björkdahl, 2020). Both for large and SMEs,

some studies have found a causal influence of agility on digitalization (Del Giudice et al., 2021; Fachrunnisa et al., 2020). Other studies, however, have found that digitalization both at the national/industry level and at the firm level influences SMEs agility (Goswami and Kumar, 2018; Škare and Soriano, 2021). Garzoni and colleagues suggest that the availability of digital technologies within the company is not sufficient: SMEs need to be incorporated in processes of incremental and disruptive change (Garzoni et al., 2020). This view is shared by other scholars (Garbellano and Da Veiga, 2019; Wang et al., 2020): digital technologies impact on SMEs strategies, processes and, ultimately, performance when they are integrated in the business. In this case what is more important than the availability of technologies is the capability of integrating them with the business. The literature identifies this capability as IT capability (Ravichandran, 2018) or digital capability (Proksch et al., 2021) or digital technologies capability (Wardaya et al., 2019). Building on the work by Ravichandran, we conceptualize digital technologies capability as a capability reflected in the flexibility of the IT infrastructure of the firm and the scope of the technologies that are adopted by the firm (Ravichandran, 2018).
Based on the above discussion we formulate the following hypothesis:
H1: Digital technologies capability has a direct positive impact on organizational agility of SMEs.

3.2 Relational capability and organizational agility in SMEs
Several studies focus, in particular, on operational agility in the context of supply chains, focus on the role of relationships with external partners (Yang, 2014; Yusuf et al., 2014). The ability to develop and maintain relationships both internally and externally, or relational capability, has been found to have an impact also on strategic and market agility (Carmeli and Dothan, 2017; Nyamrunda and Freeman, 2021). Knowledge of the partners, also mediated by digital technologies, is found to foster agility (Mandal, 2018). Trust favors a positive attitude towards change as well as a successful adaptation to new situations (Chen, 2019). The use of digital technologies for coordination with external actors is also found to have a positive impact on agility at the operational and strategic level (Nazir and Pinsonneault, 2021). The use of external resources to compensate for the lack of internal resources is a characteristic of SMEs (Hervas-Oliver et al., 2021). Several studies have found that leveraging external networks is a strategy SMEs use to develop agility (Felício et al., 2018; Jørgensen et al., 2010). The capability to create social bonds, manage external communication and share knowledge has a positive impact on the agility of SMEs at the operational, customer, and strategic level (Nyamrunda and Freeman, 2021) in particular in the context of uncertain and complex environments (Naughton et al., 2020) and of digitalized interactions (Shiranifar et al., 2019).
Thus, based on the above, we propose our next hypothesis as follows:
H2: Relational capability has a direct positive impact on organizational agility of SMEs.

3.3 Innovation capability and organizational agility in SMEs
Firms differ greatly in their attitude towards novelty and new technology in particular. Some firms are more tolerant to uncertainty and prone to taking risks, while others are more conservative (Hurley and Hult, 1998). Learning and experimenting are a prerequisite for change in organizations (Sosna et al., 2010). The ability to generate new ideas and solution, however, is not in itself sufficient to innovate. Several studies have highlighted the importance of new initiatives to be integrated with the rest of the organization (Govindarajan and Trimble, 2005). Even if some studies argued that new initiatives are more likely to be successful if separated from the core organization (Christensen, 2013), more recent studies suggest that this might be limited to the case of radical product innovations (Ravichandran, 2018). Innovation capacity or capability is the ability to successfully introduce novelties in the organization as a result of innovativeness, risk taking and entrepreneurial orientation on the one hand and of the ability to integrate them into the business on the other (Ravichandran, 2018). Some studies highlight the difficulty for SMEs to develop innovation capability due to their resource constraints (Felício et al., 2018). In general, however,

SMEs are able to develop ambidexterity and innovation capability, leveraging external resources (Jørgensen et al., 2010) or internal human capital (Cucculelli and Bettinelli, 2015; De Martino and Magnotti, 2018). In SMEs that successfully develop innovative capability, the ability to modify organizational competences and practices are also observed (Boly et al., 2014). Kohtamäki and colleagues highlight how the entrepreneurial orientation and absorptive capacity of SMEs are prerequisites for agility (Kohtamäki et al., 2020). The tight coupling of new practices with resources and capacities already present in the organization, besides, makes it easier to create new products and services, access new markets or rethink business models (Ravichandran, 2018). Thus, we posit:

H3: Innovation capability has a direct positive impact on organizational agility of SMEs.

3.4 Organizational agility and financial performance in SMEs

The extant literature points to the positive impact of organizational agility on firm performance. Roberts and Grover (2012) concluded that agility strengthens the competitive position of firms. Further, Tallon and Pinsonneault (2011) found that the ability to detect and respond to opportunities and threats with ease, speed, and dexterity has a positive effect on firm performance, in particular, in volatile environments. Agility positively affects financial performance (Ravichandran, 2018). A positive effect on financial performance has been noted both in the case of operational (Al-Nimer, 2019), strategic (Shin et al., 2015) and market agility (Zhou et al., 2019). Large firms provided the context for most of these studies and the relationship between agility and SME performance is understudied. The scant evidence suggests that in turbulent environments agility positively affects financial performance (Benzidia and Makaoui, 2020; Shin et al., 2015). Moreover, agility allows SMEs to leverage knowledge leading to performance improvement (Audretsch and Belitski, 2021). As a consequence of the above discussion we posit that:

H4: Organizational agility has a direct positive impact on the financial performance of SMEs.

3.5 Organizational agility and innovation performance in SMEs

As mentioned above, agility has a positive impact on several aspects of performance, in particular in a turbulent environment (Ravichandran, 2018; Roberts and Grover, 2012; Tallon and Pinsonneault, 2011). In particular, agility facilitates business model innovation (Bhatti et al., 2021), product innovation (Puriwat and Hoonsopon, 2021) and process innovation (Kumar et al., 2017). Organizational agility is important to achieving a balance between exploration and exploitation (Clauss et al., 2020). Further, Martinez-Sanchez and colleagues have found that agility improves the innovation performance of innovative firms by facilitating ambidexterity (Martinez-Sanchez et al., 2019). In relation to SMEs, Audretsch and Belitski (2021) have found a positive relation in their study of European SMEs while Carmeli and Dothan noted how agility facilitates learning and incremental innovation in small organizations (Carmeli and Dothan, 2017). A popular distinction is between product innovation and process innovation (Hullova et al., 2016; Prajogo and Ahmed, 2006). Most papers do not consider the impact of organizational agility on the two types of innovation in SMEs separately (e.g. Audretsch and Belitski, 2021). In consideration of the above, we propose the following hypotheses:

H5: Organizational agility has a direct positive impact on product innovation performance of SMEs.
H6: Organizational agility has a direct positive impact on process innovation performance of SMEs

4. Methodology

4.1 Research setting and data collection

This study focuses on the Italian context and on SMEs as these companies are an important and representative component of the business structure of the country (Cassetta et al., 2020; Scuotto et al., 2017). In line with prior studies (see among others Chan et al., 2019), we focus on innovative SMEs. Specifically, our research was conducted with a sample of 204 innovative SMEs in Italy. These companies[1] – employing up to 249 people – are listed in a specific Business Register (available at: https://startup.registroimprese.it/) and they were 1,789 at the end of 2020 (December 31, 2020).

Data collection was done through an online survey targeted at these firms. We asked them to answer our survey using several media (in particular email and LinkedIn).

Many studies have highlighted that an online channel is the most appropriate in collecting survey data as it does not have space and time barriers (Couper, 2017; Evans and Mathur, 2005, 2018; Selm, 2006).

First, we conducted a pilot-study consisting of seven SMEs to obtain feedback and refine the readability of the constructs (Ruel et al., 2016). This phase was also useful in assessing the survey's completeness and correctness, i.e. get information about the clarity of the measures and the familiarity with the topics (Podsakoff et al., 2012). This helped us to fine-tune the questions.

The survey contained an introduction page explaining both the academic research scope and the anonymity of the participants, and it was hosted on an online University platform. The initial message explained also the aims of the research[2].

In order to obtain responses from individuals with a good overall knowledge of the company, the survey was addressed to the CEO of the company or comparable title such as the general manager.

In order to reduce retrieval bias (Kline et al., 2000) and common method biases (CMBs) (Podsakoff et al., 2003) we intermixed the items from the different constructs in the questionnaires.

Data collection lasted two months, from January to February 2021. We initially received 335 responses (about 19% of the population), out of which 204 forms were fully complete, hence we deleted 131 incomplete questionnaires.

As a further step of our analyses, we verified the quality of the responses after the data collection. In order to check for biases related to insufficient effort responses (IER) (Costa and McCrae, 2008; DeSimone et al., 2015; Huang et al., 2012) we looked at the presence of longstrings (sequences of responses in the same category by an individual). In our case, no response category had a single string longer than five, so we can hold no evident sign of systematic IER (Costa and McCrae, 2008; Huang et al., 2012). The characteristics of the final sample of 204 respondents are reported in Table 1.

Table 1. Sample characteristics

Industry sector	Service activities and utilities	34%
	Manufacturing	33%
	ICT	10%
	Financial, insurance and banking activities	5%
	Healthcare	4%
	Trade and retail	3%
	Agri-food	3%
	Construction	2%
	Transportation	2%
	R&D	2%
	Real Estate	1%
	Others	1%

[1] SMEs are companies that employ up to 249 people and with a maximum annual turnover of 50 million euros.

[2]This additional step, i.e. to provide this initial message, is useful to avoid potential risks related to the lack of understandings by respondents, at the same time, we included a box for additional comments and extra feedback (in particular we included boxes in each page of the online questionnaire to give the opportunity to the respondents to highlight issues of their lack of understanding, and no one box was filled).

Geographical location	North Center South and Islands	54% 24% 22%
Number of employees	0-4 5-9 10-19 20-49 50-249	17% 21% 27% 18% 17%

4.2 Measures

The measures used in this study are reported in Table 2 and they were anchored on a seven-point Likert scale. The participants' answers to the survey are quantified with a standard scale for analysis ranging from one (strongly disagree), to seven (strongly agree). After the pilot-test (mentioned above), we asked five experts who have high expertise in the domain of this research for their opinions. This additional step helped us to fine-tune the questions and to enhance both the readability and comprehensiveness. The process of iteration led us to finalize our questions (Table 2 shows the measures used).

In order to measure digital technology capability (DTC) we adopted two dimensions: IT infrastructure flexibility (IF) and application digital technology (ADT). Consistent with prior studies (Armstrong and Sambamurthy, 1999; Duncan, 1995; Ravichandran, 2018; Ravichandran and Lertwongsatien, 2005), the first dimension was measured using a five-item scale. As regards the second dimension, instead, it was measured by assessing the number of digital technologies used by the SMEs. Specifically, we asked them to indicate which of the following technologies have been adopted in their organization: big data analytics, blockchain, cloud computing, electronic commerce, Business Intelligence, Artificial Intelligence, mobile computing, social media, Internet of Things, digital platforms. This measure was adapted from previous studies (Overby et al., 2006; Ravichandran, 2018; Sambamurthy et al., 2003) and it includes the emerging technologies discussed in recent researches (Cassetta et al., 2020; Papadopoulos et al., 2020).

Relational capability (RC) was classified according to the 4 items scale by Ojha et al. (2014), while the classification of innovation capability (IC) followed the study of Ravichandran (2018). The latter was function of both firm innovativeness (FI) – a five-item scale which were adapted from Hurley and Hult's (1998) study – and coupling (COUP), a single item scale.

In line with prior studies (Bhatti et al., 2021; Cegarra-Navarro et al., 2016), we measured Organizational agility (OA) with a construct of six items.

Financial performance (FP) was measured by adopting the scale used in several researches and it consisted of five items (Bhatti et al., 2021; Wamba et al., 2017; Wang et al., 2012). This choice is in line with prior scholars that recommended and/or employed subjective assessment for firm performance (McDermott and Prajogo, 2012; Tippins and Sohi, 2003). In this vein, Bhatti et al. (2021: 393) pointed out that past researchers "have recommended the use of subjective measures of performance as a valid proxy for objective performance measures".

Both product innovation (PROD) and process innovation (PROC) were measured using the scales provided by Prajogo and Ahmed (2006). These scales to gauge product and process innovation performance consisted of five and four items, respectively.

Table 2. Reliability and validity of the measures.

		Measures	OL	Cr. Alpha	rho_A	CR	AVE	R^2
IF	IF1	IT infrastructure components are standardized	0.731	0.909	0.914	0.933	0.736	--
	IF2	Connectivity of IT tools within the firm are adequate	0.882					
	IF3	Connectivity of IT tools across the supply chain are adequate	0.895					
	IF4	Data is easily sharable within and across the firm	0.852					
	IF5	Application systems are highly modular	0.882					

ADT	ADT	Digital technologies adopted by the organization*: (1) Big data analytics, (2) Blockchain, (3) Cloud computing, (4) Electronic Commerce, (5) Business Intelligence, (6) Artificial Intelligence, (7) Mobile Computing; (8) Social media, (9) Internet of Things; 10) Digital Platforms	1.000	1	1	1	1	--
RC	RC1	We work with our partners to solve problems	0.809	0.885	0.888	0.921	0.744	--
	RC2	Our partners are flexible in response to requests we make	0.905					
	RC3	Our partners make an effort to help us during emergencies	0.882					
	RC4	When an agreement is made, we can always rely on our partners to fulfill all the requirements	0.851					
FI	FI1	Risk taking is encouraged in our firm	0.690	0.837	0.844	0.885	0.609	--
	FI2	Creativity is encouraged in our firm	0.848					
	FI3	Management actively seeks innovative ideas	0.859					
	FI4	Management is tolerant to mistakes when taking risks	0.749					
	FI5	The firm is often first to market with new products and services	0.741					
COUP	COUP	Your IT-enabled new initiatives are integrated with your current business operations	1.000	1	1	1	1	--
OA	OA1	We have the ability to respond rapidly to customers' needs	0.733	0.843	0.851	0.885	0.563	0.550
	OA2	We have the ability to adapt our production/service provision rapidly to demand fluctuations	0.786					
	OA3	We have the ability to cope rapidly with problems from suppliers	0.679					
	OA4	We rapidly implement decisions to face market changes	0.853					
	OA5	We continuously search for forms to reinvent or redesign our organization	0.704					
	OA6	We see market changes as opportunities for rapid capitalization	0.734					
FP	FP1	Customer retention	0.737	0.915	0.918	0.937	0.750	0.309
	FP2	Sales growth	0.886					
	FP3	Profitability	0.927					
	FP4	Return on investment	0.912					
	FP5	Overall financial performance	0.856					
PROD	PROD1	The level of newness (novelty) of our firm's new products	0.837	0.866	0.871	0.903	0.651	0.521
	PROD2	The use of latest technological innovations in our new products	0.812					
	PROD3	The speed of our new product development	0.820					
	PROD4	The number of new products our firm has introduced to the market	0.785					
	PROD5	The number of our new products that is first-to-market (early market entrants)	0.778					
PROC	PROC1	The technological competitiveness of our company	0.842	0.930	0.937	0.950	0.827	0.533
	PROC2	The speed with which we adopt the latest technological innovations in our processes	0.934					
	PROC3	The updatedness or novelty of the technology used in our processes	0.935					
	PROC4	The rate of change in our processes, techniques and technology	0.925					

Notes: OL = outer loadings, CR = composite reliability, AVE = average variance extracted.
* (we asked to "Pick all that apply")

4.3 Data Analysis

The analysis for this study was conducted adopting the Partial-Least Squares approach to structural equation modeling with SmartPLS 3.3.3 software (Ringle et al., 2015). The adoption of the PLS-SEM technique was useful because it helps to yield accurate results in exploratory studies (Hair et al., 2019) and – at the same time – it allows the testing of the model without sample restrictions on the survey (Willaby et al., 2015). This approach is also suggested for small sample size and when there are only a few indicators for each latent variable (Hair et al., 2019). Based on the above, this method is appropriate for synthesizing an exploratory research like the present one.

In order to check for the presence of Common Method Bias (CMB), we have adopted the full-collinearity approach by (Koch and Lynn (2012). Accordingly, in our model there is a low risk of CMB as the higher inner VIF (the VIF calculated between the latent variables) is lower than the value of 3.3 (in our case the higher value is 1.83 for OA and IC).
Following the usual approach for the PLS-SEM (Hair et al., 2016; Henseler et al., 2009; Ravand and Baghaei, 2016) we have studied the model with a 2-steps process: (1) quality of the outer (measurement) model, and (2) the assessment of the inner (structural) model predictive power.

Measurement Model

To check the quality of the outer model we tested for the indicator reliability, and found no item had an outer loading lower than the minimum value of 0.6 (Chin, 1998, Henseler et al., 2009). The constructs have been considered reliable as all their Cronbach Alpha (Hair et al., 2016), their Dillon-Goldstein's rho (Chin, 1998), and their Composite Reliability (Hair, et al., 2016) are all higher than 0.7. The constructs pass the Convergent validity test (Hair et al., 2016), the Average variance extracted (AVE) is always higher than 0.50 (the lower one is 0.563 for OA).
To check for the constructs's Discriminant validity we used the Cross-loading approach by Ravand and Baghaei (2016).
As shown in Table 2 and in the following Table 3, our final model passes all the measurement model validity tests.

Table 3. Discriminant validity.

	IF	ADT	RC	FI	COUP	OA	FP	PROD	PROC
IF1	**0.731**	0.292	0.380	0.373	0.482	0.514	0.376	0.432	0.466
IF2	**0.890**	0.297	0.438	0.487	0.577	0.565	0.449	0.488	0.569
IF3	**0.910**	0.272	0.435	0.389	0.491	0.472	0.409	0.425	0.471
IF4	**0.864**	0.286	0.370	0.418	0.486	0.460	0.328	0.426	0.504
IF5	**0.883**	0.361	0.416	0.454	0.531	0.521	0.349	0.526	0.584
ADT	0.351	**1.000**	0.255	0.375	0.444	0.372	0.319	0.321	0.363
RC1	0.423	0.294	**0.809**	0.551	0.457	0.505	0.442	0.515	0.481
RC2	0.394	0.176	**0.905**	0.437	0.400	0.431	0.380	0.386	0.391
RC3	0.401	0.210	**0.882**	0.430	0.386	0.394	0.403	0.382	0.402
RC4	0.414	0.185	**0.851**	0.489	0.394	0.445	0.294	0.390	0.346
FI1	0.302	0.264	0.387	**0.690**	0.379	0.508	0.326	0.427	0.446
FI2	0.395	0.284	0.481	**0.848**	0.447	0.455	0.223	0.478	0.468
FI3	0.463	0.402	0.445	**0.859**	0.524	0.526	0.338	0.571	0.569
FI4	0.378	0.210	0.439	**0.749**	0.463	0.414	0.272	0.342	0.452
FI5	0.383	0.290	0.428	**0.741**	0.586	0.636	0.395	0.698	0.633
COUP	0.599	0.444	0.479	0.617	**1.000**	0.607	0.458	0.581	0.665
OA1	0.502	0.229	0.395	0.406	0.440	**0.733**	0.479	0.529	0.501
OA2	0.463	0.266	0.360	0.455	0.449	**0.786**	0.457	0.563	0.566
OA3	0.425	0.229	0.406	0.368	0.399	**0.679**	0.337	0.497	0.445
OA4	0.529	0.304	0.437	0.544	0.551	**0.853**	0.447	0.655	0.666
OA5	0.341	0.291	0.403	0.553	0.459	**0.704**	0.352	0.455	0.538
OA6	0.379	0.350	0.351	0.592	0.423	**0.734**	0.420	0.533	0.550
FP1	0.478	0.285	0.412	0.363	0.415	0.473	**0.737**	0.445	0.482
FP2	0.378	0.279	0.399	0.317	0.401	0.495	**0.886**	0.425	0.531
FP3	0.374	0.294	0.380	0.325	0.394	0.489	**0.927**	0.398	0.515
FP4	0.392	0.288	0.387	0.362	0.410	0.511	**0.912**	0.480	0.569
FP5	0.297	0.229	0.335	0.348	0.358	0.427	**0.856**	0.362	0.491
PROD1	0.416	0.342	0.448	0.633	0.533	0.594	0.414	**0.837**	0.690
PROD2	0.486	0.296	0.439	0.573	0.546	0.593	0.447	**0.812**	0.728
PROD3	0.491	0.231	0.464	0.540	0.478	0.657	0.400	**0.820**	0.690
PROD4	0.372	0.162	0.345	0.412	0.379	0.536	0.387	**0.785**	0.582

PROD5	0.379	0.262	0.263	0.441	0.390	0.514	0.319	**0.778**	0.610
PROC1	0.507	0.324	0.396	0.555	0.548	0.582	0.483	0.727	**0.842**
PROC2	0.589	0.322	0.455	0.603	0.606	0.708	0.570	0.764	**0.934**
PROC3	0.529	0.349	0.432	0.612	0.629	0.652	0.525	0.759	**0.935**
PROC4	0.573	0.329	0.441	0.628	0.631	0.705	0.595	0.741	**0.925**

Structural model and Hypotheses Testing

To assess the Structural Model's quality, we followed Hair et al., (2016) by looking at the structural path coefficients, defined with bootstrap with 5,000 resamples and confirmed the related predicting power of the constructs using the R^2.

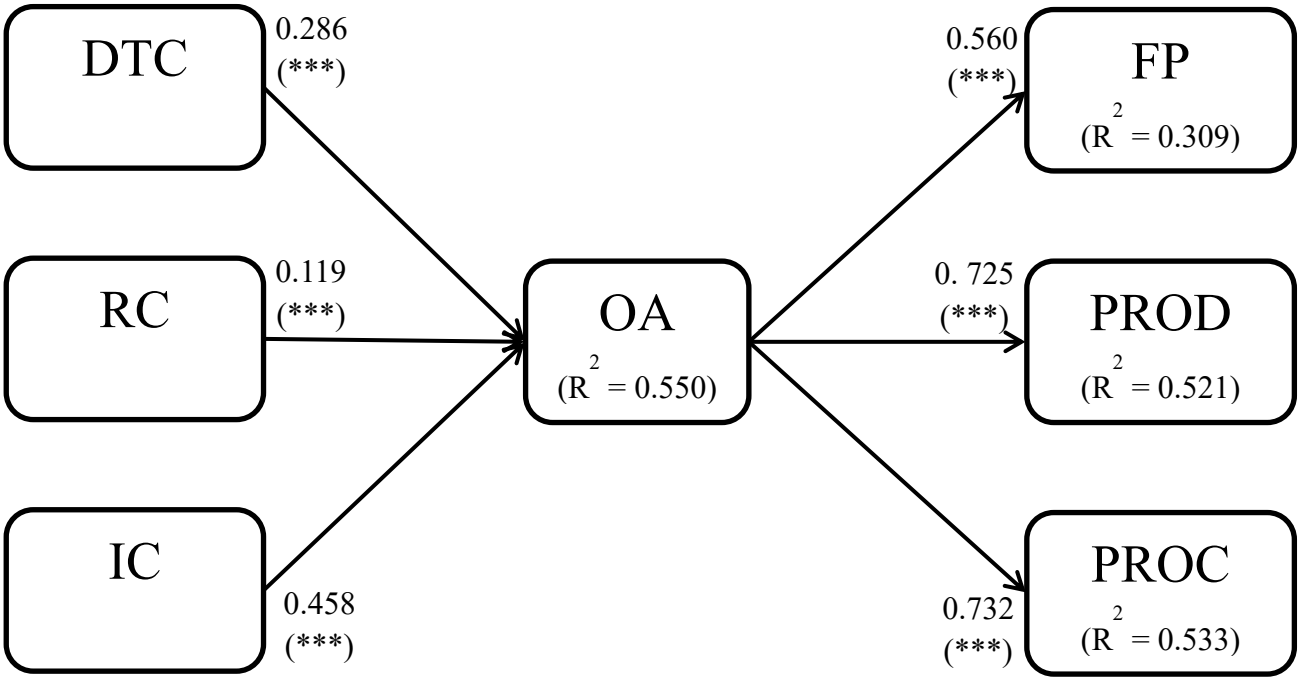
The R^2 of the endogenous constructs is reported in table 2. Using the values suggested by (Hair et al., 2016; Henseler et al., 2009) we have a low predicting power for FP (0.309) and moderate predicting power for the other three endogenous variables.

Our research has given support to all our hypotheses. In particular, OA is predicted by DTC (0.286***), RC (0.119**), and IC (0.458***). At the same time OA is predictive of FP (0.560***), PROD (0.725***), and PROC (0.732***). Table 4 shows the hypothesis testing and the related data are reported in Figure 2.

Table 4. Hypothesis testing.

	HP#	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Support
1	DTC -> OA	0.287	0.286	0.065	4.393	0.000	Yes
2	RC -> OA	0.117	0.119	0.060	1.947	0.026	Yes
3	IC -> OA	0.456	0.458	0.062	7.417	0.000	Yes
4	OA -> FP	0.556	0.560	0.049	11.345	0.000	Yes
5	OA -> PROD	0.722	0.725	0.033	22.056	0.000	Yes
6	OA -> PROC	0.730	0.732	0.033	21.897	0.000	Yes

Fig. 2. Results of the model evaluation



5. Discussion and implications

The research is attempting to advance the current knowledge on antecedents and outcomes of OA. Despite the increasing interest in OA for firms (Bhatti et al., 2021; Trost, 2019), most studies focused on Multinational Enterprises (MNEs), while SMEs are less investigated and little empirical insights are provided.

We found validation for our theoretical arguments and our hypothesis are fully supported. The results of this research show that digital technologies capability, relational capability and innovation capability are three significant antecedents of OA. These three dimensions, in fact, positively influence OA and confirms that agility is a characteristic resulting from a cluster of capabilities (Holbeche, 2018). SMEs with higher capabilities were able to enhance their OA.

In line with our H1, H2 and H3, we found that the three capabilities investigated have positive effects on SMEs' OA, thus highlighting their importance for SMEs to build OA. These findings confirm insights from prior studies, extending to SMEs the validity of relations studied for different types of companies and in particular that digital technologies capability, relational capability and innovation capability are highly relevant for companies as they are able to influence their agility in VUCA environments (e.g. Ravichandran, 2018; Shams et al. 2021).

Our findings also highlight the importance of OA in determining firm performance. The analyses show empirical consistent evidence that OA has a positive impact on financial performance as well as on the two proxies of innovation performance used, namely product and process innovation. Empirical consistent evidence supports our H4, H5 and H6, thus demonstrating that OA enhances the performance of SMEs. In this vein, our research confirms the relevance of OA as it influences firm performance (Tallon and Pinsonneault, 2011), specifically financial and innovation ones (Kumar et al., 2017; Puriwat and Hoonsopon, 2021; Ravichandran, 2018), thus showing that OA not only allow companies, and SMEs in particular. to survive the challenges of VUCA world (Rialti et al., 2019) but also get superior performance.

This study provides some contributions to research. One of the theoretical implications of the research lies in the developed and empirically tested model which consists of three drivers of OA and three outcomes. The antecedents investigated disclose the drivers that determine firms OA – i.e. the capabilities of the SMEs that influence their ability to achieve agility – and adds to the body of research on OA in particular by focusing on a less explored types of companies, namely SMEs, and by conceptualizing a new factor, namely digital technologies capability. This research, in fact, links this capability to OA and found a significant and positive relationship. In this vein, the antecedents examined extend the nascent literature on capabilities that enhance OA of firms and, at the same time, the research adds new knowledge at studies focused on the so-called 'agile behaviors of firms' (Ravichandran, 2018).

Our study responds to the call for papers that focus on both digital technologies and management innovation research in the VUCA world. Recently, studies on digital transformation are growing in numbers (Bertello et al., 2020; Bresciani et al., 2021a, 2021b) and there is a strong call for more research to increase our knowledge on the role of digital technologies and capabilities in the current scenario because they revolutionized the traditional patterns of SMEs. Moreover, the recent call for papers by Millar et al. (2018), focused on 'Management Innovation in a VUCA world' underlines the need to provide more insights in this field and to focus on the importance of innovation in the challenging environment. The scholars, in fact, argued that "We need to treat innovation not as a one-off activity" (Millar et al., 2018: 7). Our study tries to shed some new lights by exploring the innovation capability of SMEs in enabling OA and two outcomes related to the sphere of innovation, (i.e. product and process innovation).

Finally, the effects of OA are investigated in our research by exploring three different outcomes, namely financial performance, product and process innovation. These last two dimensions have not been examined separately in literature. The research adds new knowledge on two outcomes of OA that needed further investigation.

This study has also several practical implications to underline. Evidence suggests that digital technologies capability acts as an enabler of OA. Founders and managers of SMEs, in particular IT managers, should be aware of the strategic role of this capability for these companies as it leads them to be more agile. Hence, they could increase their efforts to develop this capability in order to build OA, as this study shows it contributed to this. Digital technologies have a high potential in reducing costs for SMEs and improving both their communication with stakeholders and their ability to allow for new flexible business models (Pergelova et al., 2019). Given the resource constraints of these firms (Chan et al., 2019), these technologies could play a key role for their growth and therefore it is highly relevant develop adequate capabilities to improve OA.
The findings also reveal that relational capability and innovation capability are successful drivers for enhancing OA. This supports the idea that companies should nurture both a relational and innovative culture (Felício et al., 2018; Jørgensen et al., 2010; Ravichandran, 2018).
Our study highlights that SMEs should develop these capabilities to face the current challenging scenario characterizing the VUCA world and to build enduring businesses. Higher capabilities are able to enhance OA which ultimately influences the innovation and financial performance of the firm. Hence, founders and managers of SMEs should focus on the antecedents of OA to direct their efforts in building adequate capabilities and make specific changes to achieve then superior performance (Bhatti et al., 2021).
In order to effectively and successfully leverage these capabilities, and increase both the efficiency and speed of responses to changes in the VUCA landscape, SMEs should implement specific programs aimed to build these capabilities. The enhancement of capabilities requires time (Ravichandran, 2018), hence SMEs founders/managers could offer specific training programs and adequately plan the development of these critical capabilities. In this sense, it could be crucial for SMEs to adopt a long-term orientation and focus their corporate culture, that is, to move towards a digital-based, relational and innovative culture. We propose that OA and the development of strategic capabilities could be at the top of the agenda of management teams and business executives today.
Our findings provide also useful information for governments, policymakers, public agencies and authorities. These actors, in fact, try to create favorable conditions for the growth of SMEs and incentivize their development, with close attention on what ultimately affects the performance of these companies. Therefore, understanding the conditions that enable companies to be more agile and in turn improve their performance, allows these actors to define more effective policies to encourage and stimulate specific practices or develop focused capabilities. Based on the results of this study, these actors could improve their efforts to introduce specific programs to guide companies in the proactive use of digital technologies as well as to promote companies' attitude to innovation and relations. At the same time, companies may benefit from the introduction of incentives and tax breaks for companies' digitalization in order to support and incentivize companies to invest in digital technologies and thus embark on their "digital transformation journey". In the current digital age (Troise, 2021), companies are called to nurture digital transformation and to embrace a new organizational attitude focused on the adoption, development and application of digital technologies (Schiuma et al., 2021).

6. Conclusion, limitations and avenues for future research

This paper contributes to the current debate on the role of OA in influencing firm performance and its antecedents in VUCA environments. It adds new knowledge to the emerging research field focused on OA in the digital transformation era and its key drivers and main outcomes. Our paper considers the under-investigated agility capacity of SMEs, which are especially challenged by the turbulence of this new context and experience difficulties due to their lack of resources. In particular, the paper shows that when digital technologies are integrated in the practices of the SMEs, that is, when the company develops a digital technology capability, they contribute to

increased OA. In doing so, they are complementary to capabilities traditionally associated with OA in SMEs such as innovative and relational capability. In VUCA environments this combination of capabilities might be the key for SMEs survival and success. Indeed, our findings support the hypothesis that OA, enabled by the three proposed antecedents, improves SMEs' performance, both from a financial and an innovation point of view.

From a practical point of view, the research provides useful guidelines for SMEs and their management activities in the current challenging VUCA environment. Our findings stress the importance of investing in digital technologies to become agile and thrive in VUCA environments. However, the availability of these technologies is not sufficient: a digital technology capability needs to be developed and complemented with relational and innovative capabilities.

Companies embrace digital transformation for several reasons – such as the development of advantages and the creation of sustainable values – and their adoption of new technologies significantly influences business models, customer relationships and organizational operations (Schuima et al., 2021). Our study highlights that digital technologies are also significant for SMEs' agility and thus are assuming a central role in the global landscape.

The study has some limitations that will hopefully pave the way for future research. First, this research focuses on a single country, hence future studies could investigate other contexts in order to confirm the findings and extend the current research. In particular a cross-national examination by focusing on comparisons across borders seems a relevant research opportunity to capture the scope of OA. At the same time, other measures and scales could be used to fully capture this scope. In fact, the scales adopted derived from the examined literature but other scales could be used to extend the current research and provide more in-depth insights. For example, the DTC dimension could be further developed to increase its effects. We conceptualize it by building the parameter ADT to include the scope of the technologies adopted by companies, however we consider the effects of several types of digital and we do not consider the single effects of each type of digital technologies. This represents a significant opportunity of future research because each digital technology has unique features and could provide different impacts or benefits. Moreover, future research could include moderating effects between dimensions in order to provide fully investigation of antecedents and outcomes of OA.

Another limitation of this study lies in the companies investigated, namely innovative SMEs. Our research explores this specific type of companies that contribute significantly to the country's economy (particularly in terms of creating new jobs) and have been the center of attention of many scholars for several years (Chan et al., 2019; Eshima, 2003; González-Loureiro and Dorrego, 2012; Simmie, 2002), however this could have some effect on the results or outcomes. Therefore, our findings could be extended to other countries but with caution regarding their generalizability to other types of ventures. Two interesting research opportunities arise from this. The first lies in the possibility of investigating a larger sample including SMEs with mixed innovation performance; this could be particularly useful for further validating our hypotheses and extending or confirming our findings. The second one lies in the possibility of extending this research and other types of companies could be investigated, in particular because most of the current literature focused on MNEs. Start-ups ventures, for example, are a type of company not yet investigated in this field of research despite their number is growing exponentially. The last limitation of the research is related to the sample size, i.e. 204 SMEs, hence it will be useful to increase the number of companies respondents.

References

Ahammad, M.F., Glaister, K.W., Gomes, E., 2020. Strategic agility and human resource management. Hum. Resour. Manag. Rev. 30 (1), 100700.

Akhtar, P., Khan, Z., Tarba, S., Jayawickrama, U., 2018. The Internet of Things, dynamic data and information processing capabilities, and operational agility. Technol. Forecast. Soc. Change 136, 307-316.

Al-Nimer, M., 2019. Examining the mediating role of agile supply chain approach between ERP system implementation and organizational performance. Int. J. Supply Chain. Manag. 8 (4), 107-118.

Alegre, J., Sard, M., 2015. When demand drops and prices rise. Tourist packages in the Balearic Islands during the economic crisis. Tour. Manag. 46, 375-385.

Armstrong, C.P., Sambamurthy, V., 1999. Information technology assimilation in firms: the influence of senior leadership and IT infrastructures. Inf. Syst. Res. 10 (4), 304–327.

Audretsch, D.B., Belitski, M., 2021. Knowledge complexity and firm performance: evidence from the European SMEs. J. Knowl. Manag. 25 (4), 693-713.

Bennett, N., Lemoine, G.J., 2014. What a difference a word makes: Understanding threats to performance in a VUCA world. Bus. Horiz. 57 (3), 311-317.

Benzidia, S., Makaoui, N., 2020. Improving SMEs performance through supply chain flexibility and market agility: IT orchestration perspective. *Supply Chain Forum* 21 (3), 173-184.

Bertello, A., Ferraris, A., Bresciani, S., De Bernardi, P., 2020. Big data analytics (BDA) and degree of internationalization: the interplay between governance of BDA infrastructure and BDA capabilities. J. Manag. Gov. 1-21. https://doi.org/10.1007/s10997-020-09542-w

Bhatti, S.H., Santoro, G., Khan, J., Rizzato, F., 2021. Antecedents and consequences of business model innovation in the IT industry. J. Bus. Res. 123, 389-400.

Björkdahl, J., 2020. Strategies for Digitalization in Manufacturing Firms. Calif. Manag. Rev. 62 (4), 17-36.

Bodwell, W., Chermack, T.J., 2010. Organizational ambidexterity: Integrating deliberate and emergent strategy with scenario planning. Technol. Forecast. Soc. Change 77 (2), 193-202.

Boly, V., Morel, L., Assielou, N.G., Camargo, M., 2014. Evaluating innovative processes in french firms: Methodological proposition for firm innovation capacity evaluation. Res. Polic. 43 (3), 608-622.

Brand, M., Tiberius, V., Bican, P.M., Brem, A., 2021. Agility as an innovation driver: towards an agile front end of innovation framework. Rev. Manag. Sci. 15 (1), 157-187.

Bresciani, S., Ferraris, A., Del Giudice, M., 2018. The management of organizational ambidexterity through alliances in a new context of analysis: Internet of Things (IoT) smart city projects. Technol. Forecast. Soc. Change 136, 331-338.

Bresciani, S., Ferraris, A., Romano, M., Santoro, G., 2021a. *Digital Transformation Management for Agile Organizations: A compass to sail the digital world*. Emerald Publishing Limited, Bingley, UK.

Bresciani, S., Huarng, K.H., Malhotra, A., Ferraris, A., 2021b. Digital transformation as a springboard for product, process and business model innovation. J. Bus. Res. 128 (2), 204-210.

Brink, T., 2018. Organising of dynamic proximities enables robustness, innovation and growth: The longitudinal case of small and medium-sized enterprises (SMEs) in food producing firm networks. Ind. Mark. Manag. 75, 66-79.

Carmeli, A., Dothan, A., 2017. Generative work relationships as a source of direct and indirect learning from experiences of failure: Implications for innovation agility and product innovation. Technol. Forecast. Soc. Change 119, 27-38.

Cassetta, E., Monarca, U., Dileo, I., Di Berardino, C., Pini, M., 2020. The relationship between digital technologies and internationalisation. Evidence from Italian SMEs. Ind. Innov. 27 (4), 311-339.

Cegarra-Navarro, J.G., Soto-Acosta, P., Wensley, A.K.P., 2016. Structured knowledge processes and firm performance: The role of organizational agility. J. Bus. Res. 69 (5), 1544-1549.

Chan, C.M., Teoh, S.Y., Yeow, A., Pan, G., 2019. Agility in responding to disruptive digital innovation: Case study of an SME. Inf. Syst. J. 29 (2), 436-455.
Chen, C.J., 2019. Developing a model for supply chain agility and innovativeness to enhance firms' competitive advantage. Manag. Decis. 57 (7), 1511-1534.
Chen, Y., Wang, Y., Nevo, S., Jin, J., Wang, L., Chow, W.S., 2014. IT capability and organizational performance: the roles of business process agility and environmental factors. Eur. J. Inf. Syst. 23 (3), 326-342.
Chin, W.W., 1998. Commentary: issues and opinion on structural equation modeling. MIS Q. 22 (1), vii-xvi.
Christensen, C.M., 2013. *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Harvard Business Review Press, Boston, MA.
Clauss, T., Kraus, S., Kallinger, F.L., Bican, P.M., Brem, A., Kailer, N., 2020. Organizational ambidexterity and competitive advantage: The role of strategic agility in the exploration-exploitation paradox. J. Innov. Knowl. https://doi.org/10.1016/j.jik.2020.07.003.
Costa Jr, P.T., McCrae, R.R., 2008. The Revised NEO Personality Inventory (NEO-PI-R). In Boyle, G.J., Matthews, G., Saklofske, D.H. (Eds.), *The SAGE Handbook of Personality Theory and Assessment: Vol. 2 - Personality Measurement and Testing.* SAGE Publications Inc. Thousand Oaks - CA, 179-198.
Couper, M.P., 2017. New developments in survey data collection. Annual Rev. Sociol. 43, 121-145.
Crocitto, M., Youssef, M., 2003. The human side of organizational agility. Ind. Manag. Data Syst. 103 (6), 388-397.
Cucculelli, M., Bettinelli, C., 2015. Business models, intangibles and firm performance: evidence on corporate entrepreneurship from Italian manufacturing SMEs. Small Bus. Econ. 45, 329-350
De Martino, M., Magnotti, F., 2018. The innovation capacity of small food firms in Italy. Eur. J. Innov. Manag. 21 (3), 362-383.
DeSimone, J.A., Harms, P.D., DeSimone, A.J., 2015. Best practice recommendations for data screening. J. Organ. Behav. 36 (2), 171-181.
Del Giudice, M., Scuotto, V., Papa, A., Tarba, S.Y., Bresciani, S., Warkentin, M., 2021. A Self-Tuning Model for Smart Manufacturing SMEs: Effects on Digital Innovation. J. Prod. Innov. Manag. 38 (1), 68-89.
Demir, R., Campopiano, G., Kruckenhauser, C., Bauer, F., 2021. Strategic agility, internationalisation speed and international success - The role of coordination mechanisms and growth modes. J. Int. Manag. 27 (1), art. no. 100838.
Duncan, N.B., 1995. Capturing flexibility of information technology infrastructure: a study of resource characteristics and their measure. J. Manag. Inf. Syst. 12 (2), 37–57.
Eshima, Y., 2003. Impact of Public Policy on Innovative SMEs in Japan. J. Small Bus. Manag. 41 (1), 85-93.
Evans, J.R., Mathur, A., 2005. The value of online surveys. Internet Res.15 (2), 195-219.
Evans, J.R., Mathur, A., 2018. The value of online surveys: a look back and a look ahead. Internet Res. 28 (4), 854-887.
Fachrunnisa, O., Adhiatma, A., Lukman, N., Majid, M.N.A., 2020. Towards SMEs' digital transformation: The role of agile leadership and strategic flexibility. J. Small Bus. Strateg. 30 (3), 65-85.
Felício, J.A., Caldeirinha, V., Dutra, A., 2019. Ambidextrous capacity in small and medium-sized enterprises. J. Bus. Res. 101, 607-614.
Fernández-Mesa, A., Luis Ferreras-Méndez, J., Alegre, J., Chiva, R., 2014. IT competency and the commercial success of innovation. Ind. Manag. Data Syst. 114 (4), 550-567.
Ferraris, A., Mazzoleni, A., Devalle, A., Couturier, J., 2018. Big data analytics capabilities and knowledge management: impact on firm performance. Manag. Decis. 57 (8), 1923-1936.

Fourné, S.P., Jansen, J.J., Mom, T.J., 2014. Strategic agility in MNEs: Managing tensions to capture opportunities across emerging and established markets. Calif. Manag. Rev. 56 (3), 13-38.
Garbellano, S., Da Veiga, M.R., 2019. Dynamic capabilities in Italian leading SMEs adopting industry 4.0. Meas. Bus. Excell. 23 (4), 472-483.
Garzoni, A., De Turi, I., Secundo, G., Del Vecchio, P., 2020. Fostering digital transformation of SMEs: a four levels approach. Manag. Decis. 58 (8), 1543-1562.
Ghasemaghaei, M., Hassanein, K., Turel, O., 2017. Increasing firm agility through the use of data analytics: The role of fit. Decis. Support Syst. 101, 95–105.
Gligor, D., Holcomb, M., Maloni, M.J., Davis-Sramek, E., 2019. Achieving financial performance in uncertain times: Leveraging supply chain agility. Transp. J. 58 (4), 247-279.
González-Loureiro, M., Dorrego, P.F., 2012. Intellectual capital and system of innovation: What really matters at innovative SMEs. Intang. Cap. 8 (2), 239-274.
Goswami, M., Kumar, G., 2018. An investigation of agile manufacturing enablers in Indian automotive SMEs using structural equation model. Meas. Bus. Excell. 22 (3), 276-291.
Govindarajan, V., Trimble, C., 2005. Organizational DNA for Strategic Innovation. Calif. Manag. Rev. 47 (3), 47-76.
Haider, S.A., Martins, J.M., Khan, S., Mata, M.N., Tehseen, S., Abreu, A., 2021. A literature review on agility-is there a need to develop a new instrument?. Int. J. Entrepreneursh. 25 (4), 1-14.
Hair Jr, J.F., Hult, G.T.M., Ringle, C., Sarstedt, M., 2016. *A primer on partial least squares structural equation modeling (PLS-SEM).* Sage-Publications.
Hair, F., Risher, J.J., Sarstedt, M., Ringle C.M., 2019. When to use and how to report the results of PLS-SEM. Eur. Bus. Rev. 31 (1), 2-24.
Henseler, J., Ringle, C., Sinkovics, R., 2009. The use of partial least squares path modeling in international marketing. In Sinkovics, R., Ghauri, P. (Eds), *New Challenges to International Marketing.* Emerald Group Publishing Limited, Bingley, 20, 277-319.
Hervas-Oliver, J.L., Sempere-Ripoll, F., Boronat-Moll, C., 2021. Technological innovation typologies and open innovation in SMEs: Beyond internal and external sources of knowledge. Technol. Forecast. Soc. Change 162, 120338.
Holbeche, L., 2018. *The agile organization: How to build an engaged, innovative and resilient business*. Kogan Page Publishers.
Huang, J.L., Curran, P.G., Keeney, J., Poposki, E.M., DeShon, R.P., 2012. Detecting and deterring insufficient effort responding to surveys. J. Bus. Psychol. 27 (1), 99-114.
Hullova, D., Trott, P., Simms, C.D., 2016. Uncovering the reciprocal complementarity between product and process innovation. Res. Polic. 45 (5), 929-940.
Hurley, R.F., Hult, G.T.M., 1998. Innovation, market orientation, and organizational learning: an integration and empirical examination. J. Mark. 62 (3), 42-54.
Jagtap, S., Duong, L.N.K., 2019. Improving the new product development using big data: A case study of a food company. Br. Food J. 121 (11), 2835-2848.
Jamal, N.M., Yi, W.S., Chin, T.A., Idris, N., 2019. Effects of supply chain flexibility towards supply chain collaboration and supply chain agility. Int. J. Supply Chain Manag. 8 (1), 170-173.
Jermsittiparsert, K., Wajeetongratana, P., 2019. The role of organizational culture and it competency in determining the supply chain agility in the small and medium-size enterprises. Int. J. Innov. Creat. Change 5 (2), 416-431.
Jørgensen, F., Ulhøi, J.P., 2010. Enhancing innovation capacity in SMEs through early network relationships. Creat. Innov. Manag. 19 (4), 397-404.
Joshi, K.D., Chi, L., Datta, A., Han, S., 2010. Changing the competitive landscape: continuous innovation through IT-enabled knowledge capabilities. Inf. Syst. Res. 21 (3), 472-495.
Kane, G.C., Palmer, D., Phillips, A.N., Kiron, D., 2015. Is your business ready for a digital future?. MIT Sloan Manag. Rev. 56 (4), 37-44.

Khan, S.H., Majid, A., Yasir, M., 2020. Strategic renewal of SMEs: the impact of social capital, strategic agility and absorptive capacity. Manag. Decis. https://doi.org/10.1108/MD-12-2019-1722

Kline, T.J., Sulsky, L.M., Rever-Moriyama, S.D., 2000. Common method variance and specification errors: a practical approach to detection. J. Psychol 134 (4), 401-421.

Kock, N., Lynn, G., 2012. Lateral collinearity and misleading results in variance-based SEM: an illustration and recommendations. J. Assoc. Inf. Syst. 13 (7), 546-580.

Kohtamäki, M., Parida, V., Patel, P.C., Gebauer, H., 2020. The relationship between digitalization and servitization: The role of servitization in capturing the financial potential of digitalization. Technol. Forecast. Soc. Change 151, 119804.

Kumar, V., Verma, P., Sharma, R.R.K., Khan, A.F., 2017. Conquering in emerging markets: critical success factors to enhance supply chain performance. *Benchmarking* 24 (3), 570-593.

Li, H., Wu, Y., Cao, D., Wang, Y., 2021. Organizational mindfulness towards digital transformation as a prerequisite of information processing capability to achieve market agility. J. Bus. Res. 122, 700-712.

Linstone, H.A., Phillips, F., 2013. The simultaneous localization–globalization impact of information/communication technology. Technol. Forecast. Soc. Change 7 (80), 1438-1443.

Liu, H., Ke, W., Wei, K.K., Hua, Z., 2013. The impact of IT capabilities on firm performance: the mediating roles of absorptive capacity and supply chain agility. Decis. Support Syst. 54 (3), 1452-1462.

Liu, H.M., Yang, H.F., 2019. Managing Network Resource and Organizational Capabilities to Create Competitive Advantage for SMEs in a Volatile Environment. J. Small Bus. Manag. 57 (S2), 155-171.

Liu, H.M., Yang, H.F., 2020. Network resource meets organizational agility: Creating an idiosyncratic competitive advantage for SMEs., Manag. Decis. 58 (1), 58-75.

Lu, Y., Ramamurthy, K.R., 2011. Understanding the Link Between Information Technology Capability and Organizational Agility: An Empirical Examination. MIS Q. 35 (4), 931-954.

Lucas Jr, H.C., Goh, J.M., 2009. Disruptive technology: How Kodak missed the digital photography revolution. J. Strateg. Inf. Syst. 18 (1), 46-55.

Mandal, S., 2018. An examination of the importance of big data analytics in supply chain agility development: A dynamic capability perspective. Manag. Res. Rev. 41 (10), 1201-1219.

Martínez-Climent, C., Rodríguez-García, M., Ribeiro-Soriano, D., 2019. Digital transformations and value creation in international markets. Int. J. Entrep. Behav. Res. 25 (8), 1603-1604.

Martinez-Sanchez, A., Perez-Perez, M., Vicente-Oliva, S., 2019. Absorptive capacity and technology: influences on innovative firms. Manag. Res. 17 (3), 250-265.

McDermott, C.M., Prajogo, D.I., 2012. Service innovation and performance in SMEs. Int. J. Oper. Prod. Manag. 32 (2), 216-237.

Millar, C.C., Groth, O., Mahon, J.F., 2018. Management innovation in a VUCA world: Challenges and recommendations. Calif. Manag. Rev. 61 (1), 5-14.

Naughton, S., Golgeci, I., Arlsan, A., 2020. Supply Chain Agility as an Acclimatisation Process to Environmental Uncertainty and Organisational Vulnerabilities: Insights from British SMEs. Prod. Plan. Control 31(14), 1164-1177

Nazir, S., Pinsonneault, A., 2021. Relating agility and electronic integration: The role of knowledge and process coordination mechanisms. J. Strateg. Inf. Syst. 30 (2), 101654.

Neirotti, P., Raguseo, E., 2017. Flexible work practices and the firm's need for external orientation: An empirical study of SMEs. J. Enterp. Inf. Manag. 30, 922–943.

Nyamrunda, F.C., Freeman, S., 2021. Strategic agility, dynamic relational capability and trust among SMEs in transitional economies. J. World Bus. 56 (3), 101175.

Ojha, D., Salimath, M., D'Souza, D., 2014, Disaster immunity and performance of service firms: The influence of market acuity and supply network partnering. Int. J. Prod. Econ. 147 (Part B), 385-397

Overby, E., Bharadwaj, A., Sambamurthy, V., 2006. Enterprise agility and the enabling role of information technology. Eur. J. Inf. Syst. 15 (2), 120–131.

Papadopoulos, T., Baltas, K.N., Balta, M.E., 2020. The use of digital technologies by small and medium enterprises during COVID-19: Implications for theory and practice. Int. J. Inf. Manag. 55, 102192.

Pellizzoni, E., Trabucchi, D., Buganza, T., 2019. When agility meets open innovation: two approaches to manage inbound projects. Creat. Innov. Manag. 28 (4), 464-476.

Pergelova , L., Manolova, T., Simeonova-Ganeva, R., Yordanova, D., 2019. Democratizing Entrepreneurship? Digital Technologies and the Internationalization of Female-Led SMEs. J. Small Bus. Manag. 57 (1), 14–39.

Phillips, F., Linstone, H., 2016. Key ideas from a 25-year collaboration at technological forecasting & social change. Technol. Forecast. Soc. Change 105, 158-166.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y., Podsakoff, N.P., 2003. Common method biases in behavioral research: a critical review of the literature and recommended remedies. J. Appl. Psychol 88 (5), 879-903.

Podsakoff, P.M., MacKenzie, S.B., Podsakoff, N.P., 2012. Sources of method bias in social science research and recommendations on how to control it. Annual Rev. Psychol 63, 539-569.

Prajogo, D.I., Ahmed, P.K., 2006. Relationships between innovation stimulus, innovation capacity, and innovation performance. R&D Manag. 36 (5), 499-515.

Proksch, D., Rosin, A.F., Stubner, S., Pinkwart, A., 2021. The influence of a digital strategy on the digitalization of new ventures: The mediating effect of digital capabilities and a digital culture. J. Small Bus. Manag. https://doi.org/10.1080/00472778.2021.1883036.

Puriwat, W., Hoonsopon, D., 2021. Cultivating product innovation performance through creativity: the impact of organizational agility and flexibility under technological turbulence. J. Manuf. Technol. Manag. https://doi.org/10.1108/JMTM-10-2020-0420.

Qosasi, A., Permana, E., Muftiadi, A., Purnomo, M., Maulina, E., 2019. Building SMEs' competitive advantage and the organizational agility of apparel retailers in Indonesia: The role of ICT as an initial trigger. Gadjah Mada Int. J. Bus. 21 (1), 69-91.

Ravand, H., Baghaei, P., 2016. Partial least squares structural equation modeling with R. Pract. Assess. Res. Eval. 21 (11), 1-16.

Ravichandran, T., 2018. Exploring the relationships between IT competence, innovation capacity and organizational agility. J. Strateg. Inf. Syst. 27 (1), 22-42.

Ravichandran, T., Lertwongsatien, C., 2005. Effect of information systems resources and capabilities on firm performance: a resource-based perspective. J. Manag. Inf. Syst. 21 (4), 237–276.

Ray, G., Muhanna, W.A., Barney, J.B., 2005. Information technology and the performance of the customer service process: a resource-based analysis. MIS Q. 29 (4), 625-652.

Rialti, R., Zollo, L., Ferraris, A., Alon, I., 2019. Big data analytics capabilities and performance: Evidence from a moderated multi-mediation model. Technol. Forecast. Soc. Change 149, 119781.

Ringle, C.M., Wende, S., Becker, J.M., 2015. SmartPLS 3. Boenningstedt: SmartPLS GmbH. Retrieved from https://www. smartpls.com.

Roberts, N., Grover, V., 2012. Leveraging information technology infrastructure to facilitate a firm's customer agility and competitive activity: an empirical investigation. J. Manag. Inf. Syst. 28 (4), 231-270.

Rozak, H.A., Adhiatma, A., Fachrunnisa, O., Rahayu, T. 2021. Social Media Engagement, Organizational Agility and Digitalization Strategic Plan to Improve SMEs' Performance. IEEE Trans. Eng. Manag., doi:10.1109/TEM.2021.3085977.

Ruel, E.E., Wagner, W.E., Gillespie, B.J., 2016. *The practice of survey research*. Sage Publications, Thousand Oaks, CA.

Sambamurthy, V., Bharadwaj, A., Grover, V., 2003. Shaping agility through digital options: reconceptualizing the role of information technology in contemporary firms. MIS Q. 27 (2), 237-263.

Schiuma, G., Schettini, E., Santarsiero, F., Carlucci, D., 2021. The transformative leadership compass: six competencies for digital transformation entrepreneurship. Int. J. Entrep. Behav. Res.. https://doi.org/10.1108/IJEBR-01-2021-0087.

Scuotto, V., Santoro, G., Bresciani, S., Del Giudice, M., 2017. Shifting intra-and inter-organizational innovation processes towards digital business: an empirical analysis of SMEs. Creat. Innov. Manag. 26 (3), 247-255.

Selm, M.V., 2006. Conducting Online Surveys. Qual Quant. 40, 435-456.

Shams, R., Vrontis, D., Belyaeva, Z., Ferraris, A., Czinkota, M.R., 2021. Strategic agility in international business: A conceptual framework for "agile" multinationals. J. Int. Manag. 27, 100737.

Shin, H., Lee, J.N., Kim, D., Rhim, H., 2015. Strategic agility of Korean small and medium enterprises and its influence on operational and firm performance. Int. J. Prod. Econ. 168, 181-196.

Shiranifar, A., Rahmati, M., Jafari, F., 2019. Linking IT to supply chain agility: Does knowledge management make a difference in SMEs?. Int. J. Logis. Syst. Manag. 34 (1), 123-138.

Simmie, J., 2002. Knowledge Spillovers and Reasons for the Concentration of Innovative SMEs. Urban Stud. 39 (5-6), 885-902.

Škare, M., Soriano, D.R., 2021. A dynamic panel study on digitalization and firm's agility: What drives agility in advanced economies 2009–2018. Technol. Forecast. Soc. Change 163, 120418.

Sosna, M., Trevinyo-Rodríguez, R.N., Velamuri, S.R., 2010. Business model innovation through trial-and-error learning: The naturhouse case. Long Range Plan. 43 (2-3), 383-407.

Swafford, P.M., Ghosh, S., Murthy, N., 2008. Achieving supply chain agility through IT integration and flexibility. Int. J. Prod. Econ. 116 (2), 288-297.

Tallon, P.P., 2008. Inside the adaptive enterprise: an information technology capabilities perspective on business process agility. Inf. Technol. Manag. 9 (1), 21-36.

Tallon, P.P., Pinsonneault, A., 2011. Competing perspectives on the link between strategic information technology alignment and organizational agility: Insights from a mediation model. MIS Q. 35 (2), 463–486.

Tan, F.T.C., Tan, B., Wang, W., Sedera, D., 2017. IT-enabled operational agility: An interdependencies perspective. Inf. Manag. 54 (3), 292-303

Teece, D., Peteraf, M., Leih, S., 2016. Dynamic capabilities and organizational agility: Risk, uncertainty, and strategy in the innovation economy. Calif. Manag. Rev. 58 (4), 13-35.

Tippins, M.J., Sohi, R.S., 2003. IT competency and firm performance: Is organizational learning a missing link?. Strateg. Manag. J. 24 (8), 745-761.

Troise, C., 2021. Exploring knowledge visualization in the digital age: an analysis of benefits and risks. Manag. Decis. https://doi.org/10.1108/MD-01-2021-0086.

Trost, A., 2019. *Human Resources Strategies: balancing stability and agility in times of digitization*. Springer Nature.

Ulas, D., 2019. Digital Transformation Process and SMEs. Procedia Comput. Sci. 158, 662-671.

van Oosterhout, M., Waarts, E., van Hillegersberg, J., 2006. Change factors requiring agility and implications for IT. Eur. J. Inf. Syst. 15 (2), 132–145.

Vecchiato, R., 2015. Creating value through foresight: First mover advantages and strategic agility. Technol. Forecast. Soc. Change 101, 25-36.

Wamba, S.F., Gunasekaran, A., Akter, S., Ren, S.F., Dubey, R., Childe, S.J., 2017. Big data analytics and firm performance: Effects of dynamic capabilities. J. Bus. Res. 70, 356–365.

Wang, N., Liang, H., Zhong, W., Xue, Y., Xiao, J., 2012. Resource Structuring or Capability Building? An Empirical Study of the Business Value of Information Technology. J. Manag. Inf. Syst. 29 (2), 325–367.

Wang, Z., Rafait Mahmood, M., Ullah, H., Hanif, I., Abbas, Q., Mohsin, M., 2020. Multidimensional Perspective of Firms' IT Capability Between Digital Business Strategy and Firms' Efficiency: A Case of Chinese SMEs. *SAGE Open* 10 (4), 1-15.

Wardaya, A., Sasmoko, S., So, I.G., Bandur, A., 2019. Entrepreneurial orientation and digital technology capabilities in small and Medium-sized Enterprises (SMEs) in Indonesia. Int. J. Recent Technol. Eng. 8 (1C2), 456-460.

Weber, Y., Tarba, S.Y., 2014. Strategic Agility: A State of the Art Introduction to the Special Section on Strategic Agility. Calif. Manag. Rev. 56 (3), 5-12.

Willaby, H.W., Costa, D.S.J., Burns, B.D., MacCann, C., Roberts, R.D., 2015. Testing complex models with small sample sizes: a historical overview and empirical demonstration of what partial least squares (PLS) can offer differential psychology. Personal. Individ. Differ. 84, 73-78.

Yang, J., 2014. Supply chain agility: Securing performance for Chinese manufacturers. Int. J. Prod. Econ. 150, 104-113.

Youssef, A.B., Boubaker, S., Dedaj, B., Carabregu-Vokshi, M., 2021. Digitalization of the economy and entrepreneurship intention. Technol. Forecast. Soc. Change 164, 120043.

Yuan, S., Musibau, H.O., Genç, S.Y., Shaheen, R., Ameen, A., Tan, Z., 2021. Digitalization of economy is the key factor behind fourth industrial revolution: How G7 countries are overcoming with the financing issues?. Technol. Forecast. Soc. Change 165, 120533.

Yusuf, Y.Y., Gunasekaran, A., Musa, A., Dauda, M., El-Berishy, N.M., Cang, S., 2014. A relational study of supply chain agility, competitiveness and business performance in the oil and gas industry. Int. J. Prod. Econ. 147 (Part B), 531-543.

Zain, M., Rose, R.C., Abdullah, I., Masrom, M., 2005. The relationship between information technology acceptance and organizational agility in Malaysia. Inf. Manag. 42 (6), 829-839.

Zhou, J., Mavondo, F.T., Saunders, S.G., 2019. The relationship between marketing agility and financial performance under different levels of market turbulence. Ind. Mark. Manag. 83, 31-41.