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**How SMEs respond to an exogenous shock:
diversification, servitization and digitalization**

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How SMEs respond to an exogenous shock: diversification, servitization and digitalization

Abstract

COVID-19 has been an exogenous shock for several businesses. Pandemic pushed firms to operate in an uncharted territory. Firms had to adapt quickly to survive in an unpredictable market and in conditions of uncertainty further fueled by political instability and environmental challenges. Based on a quantitative survey carried out during the pandemic period, the study aims at assessing how small and medium-sized enterprises (SMEs) responded to the challenges emerged during the COVID-19 outbreak, focusing on diversification and servitization strategies to outline potential new theoretical insights related to these strategies developed in turbulent times considering the function of digitalization in this respect. Through a cluster analysis the study identifies 4 groups of firms (unresponsive, defender, analyzer and prospector) that have shown different responses to the crisis related to diversification and servitization, highlighting the key role of digital technologies (both ICT and Industry 4.0) as well as of customers. The findings allowed to define theoretical and practical implications.

Keywords: digital technologies; strategy; diversification; servitization; business model innovation; COVID-19, cluster analysis

1. Introduction

The COVID-19 pandemic has deeply impacted firms' survival, due to difficulties to reach customers specifically in selected industries (Fairlie and Fossen, 2022) as well to constraints in the firm international supply chain (Pantano et al., 2020). Lockdown of manufacturing and retailing activities asked firms to rapidly rethink their business in order to reduce economic losses and competitive damages, through a proper assessment and feasibility analyses of their business models (Donthu and Gustafsson, 2020). In order to solve the emerging problems, firms embraced methods

and processes that are responsive rather than reactive to the crisis (Chesbrough, 2020), switching to new operating models focused on the customer and supported by the right governance (Verma and Gustafsson, 2020).

COVID-19 pandemic has emphasized a situation of increasing uncertainty (Sharma et al., 2020) in a VUCA (Volatility, Uncertainty, Complexity, Ambiguity) world (Mack et al., 2016) that opened new competitive challenges and offers an interesting research setting. Such scenario is in fact useful to better understand firm's reactions to crisis (e.g. Venetoklis, 2021) and strategic behavior of firms in turbulent times. As an exogenous global crisis, COVID-19 pandemic impacted on different industries and firms at the international level in terms of sales (Fairlie and Fossen, 2022), challenging in particular small and medium-sized enterprises (SMEs) and entrepreneurial growth (Meahjohn and Persad, 2020).

Strategic management studies have highlighted how in times of crisis there is an opportunity of strategic renewal, where firms may diversify their business by investing in new products, new services and/or new markets (Naidoo, 2010). Firms may adopt different strategic behaviors to cope with environmental challenges and solve entrepreneurial problems to effectively compete. In this regard, Miles and Snow's research (1978) pointed out that firms may have a proactive (prospectors), defensive (defender), analytical (analyzer), or reactive strategy in relations to environmental pressures, reflecting different degrees of innovation (and risk-taking level) in terms of market and growth opportunities. This theoretical perspective has been applied in different management research (see Anwar et al., 2021 for a review) and shows to be particularly useful to provide a general framework in which to outline the consequences of the COVID-19 competitive scenario (Chong and Duan, 2022). Research carried out during the pandemic has shown that COVID-19 crisis has accelerated innovation processes on products and markets not because firms want to innovate but because they had to (Heinonen and Strandvik, 2020), as already shown in past turbulent periods (Cucculelli and Peruzzi, 2020).

In this perspective, a first focus refers to how firms approach product and market innovation, that

is to what extent in a condition of crisis firms can diversify (or not) its business by revising its product-market alternatives through market penetration, product or market development, up to a more radical (risky) diversification entering into new markets with new products (Ansoff, 1965). Initial research on firms during COVID-19 show that firms may expand or revise their strategies by revising their existing products or developing new ones, also in the direction of new market expansion, or acquiring new customer (Wang et al., 2020). Especially during COVID-19 pandemic, digital technologies have been particularly important tools enabling firms to overcome the limits of physical interaction with customers and sales management (Amankwah-Amoah et al., 2021; He et al., 2021). This must be explored using the COVID-19 crisis as empirical setting (cfr. Amatulli et al., 2023) to provide further knowledge on strategy evolutions within a digitalized VUCA economy.

A second, interrelated, focus refers to strategic renewal at the business model level. It becomes relevant to consider how firms redesign their offering up to a complete business model innovation (BMI) process (Mitchell and Bruckner Coles, 2004). Research highlights the potentialities of crises as source of opportunity for firms specifically in pursuing BMI (Ritter and Pedersen, 2020) as a far more advanced strategic path for value creation and capture (Foss and Saebi, 2017) and a more advanced radical forms of innovation (Geissdoerfer et al., 2018) that not necessarily all firms may follow in a prospector, defender, or reactor view in the same way. Within the research on BMI, servitization has been highlighted as a relevant driver (Foss and Saebi, 2017), also considered in relation to digitalization (Paiola and Gebauer, 2020). Servitization refers to the shift in the firm's offering from products to solutions (Baines et al., 2011), where the value creation is not related to selling tangible products but a more complex and rich bundle of elements (goods, services, supports etc.) (Vandermerwe and Rada, 1988). From this perspective, servitization has been considered a promising strategic shift for manufacturing firms, specifically in high-competitive contexts (Cusumano et al., 2015; Lightfoot et al., 2013) and with a proactive approach with respect to defensive and reactive typologies of firms (Taran et al. 2015). As emerged during both COVID-19 pandemic as well as other turbulent times, servitization, which focuses on service-centric business model

(Kowalkowski et al., 2017), positively stabilizes businesses and sustains competitiveness also in connection with digitalization (Kwak and Kim, 2016; Rapaccini et al., 2020). Nevertheless, shifting towards business models rooted on servitization is challenging under multiple perspectives and specifically requires investing in co-creation (Zhang and Banerji, 2017).

Considering the above-mentioned theoretical arguments, it is interesting to explore how firms adapted their strategies among the different typologies theoretically proposed by Miles and Snow (1978), considering not only the pressure posed by the COVID-19 but also the potentialities offered by digital technologies. Indeed, the paper aims at investigating how firms – specifically SMEs – react to exogenous, rapidly emerging crisis by considering the alternative strategic approaches defined by Miles and Snow (1978), in the competitive scenario shaped by the new technological fourth industrial revolution. Specifically, referring to the COVID-19 as empirical scenario, the paper examines the development of diversification strategies (as product and/or market innovation) as well as servitization strategies, as a proxy for business model innovation (new form of value creation), as responses to the pandemic crisis and the role of technologies for firms' responses, as strategic tools used to link the firm with the different actors (suppliers, customers and employees too). In so doing the paper aims at answering to the following research questions:

RQ1: How do firms respond to challenges posed by exogenous global crisis in terms of diversification and servitization?

RQ2: Are there different strategic behaviors in terms of diversification and servitization?

RQ3: How do firms use (or not) digital technologies for facing the crisis and how this is related to their strategic behaviors?

This analysis is relevant to provide additional knowledge in the understanding of the strategic reactions of firms in times of crisis, enriching the theoretical debates on innovation (product/market, BMI and servitization) as well as research on digital transformation. Particular attention is related to such innovation processes in the context of SMEs, which may suffer from such an exogenous event, but that could also exploit their potentialities innovation-wise (Juergensen et al., 2020; Papadopoulos

et al., 2020).

2. Theoretical background

2.1 *Diversification and servitization to face exogenous crisis*

Strategic management studies have analyzed how firms may define their strategies in relation to external environmental conditions and their changes. In their research on the adaptation of the firm to the environment Miles and Snow (Miles and Snow 1978; Miles et al., 1978) have proposed four different strategic typologies of firms that reflect different approaches towards uncertainty and consequences in terms of product-market domains. Accordingly, firms can be: 1) prospectors: that are innovative and oriented to growth, which search for new market and growth opportunities with high risk propensity; 2) defenders: firms oriented to maintain stability in relation to their market and preserve firm growth; 3) analyzer: firms interested in balancing stability and growth, by investing also in innovation and new strategic directions, but through a follower approach (with respect to prospectors); and 4) reactors: firms with no clear, stable strategies, reacting behavior to changes in the competitive environment. A radical, rapid, and deep transformation in the competitive landscape such as generated by COVID-19 represents an important change firms need to cope with, and the different above-mentioned types provide useful theoretical lenses to guide the exploration on firm's strategic behaviors in exogenous crisis such as the pandemic one.

We advance that diversification strategy is an adequate proxy to understand how firms cope with pandemic using the categories *à la* Miles and Snow (1978). In time of crisis prospectors and analyzers would be more oriented to invest in the direction of diversification, to get the advantages related to the offering of new products and/or the entering in new markets, *vis-à-vis* the issues current markets may face. Through diversification strategy a company can create a new customer base, thereby increasing the market potential. In this sense, diversification strategy – described as the degree to which a firm participates in different businesses by offering of new products and services in existing markets and/or expansion of business through existing or new products and services (Lichtenthaler,

2005) – is beneficial for firms by lowering risk in their business (Chan Kim et al., 1989). Product and market diversification offer firms the opportunity to sustain performance while making use of their resources and capabilities (Chakrabarti et al., 2007), as well as to gain benefits linked to scope-economy and risk decentralization (Kang, 2013). From this point of view diversification strategy is used by firms (and SMEs) as a revenue-generating activity that can enhance their resilience in terms of survival in recession, demonstrated also during COVID-19 pandemic (Ke et al., 2022; Netz et al., 2022; Roper and Turner, 2020). On the contrary, defenders would be more oriented to ensure stability to their current business, while reactors may fail in identifying the right strategy hence suffering in terms of competitive advantage and performance results (Parnell et al., 2015). In extreme, global crisis – such as the COVID-19 one – the need to rapidly respond to the exogenous shock may put under scrutiny the firm's approach to diversification and call for a better understanding on the proactive vs. defensive strategic behaviors adopted diversification-wise in terms of attention to product or market development or completely new product/market offering.

Strategic adaptation in relation to the environmental changes cannot occur only through diversification as a specific combination of product-market alternatives that firms can develop, but can also involve innovation at the business model level for enhanced competitive advantage and value creation (Foss and Saebi, 2017). Business model (BM) can be defined as “design or architecture of the value creation, delivery, and capture mechanisms” of a firm (Teece, 2010: 172) and innovation at the BM level (Zott et al., 2011) goes beyond product and market innovation, to broadly refers to remarkable changes in the BM elements or architectures. In this respect, prospectors are more oriented towards radical BMI with respect to reactors, whose innovativeness is low, while defender and analyzers could have a more cautious (medium-level degree of innovativeness) approach to BMI (Taran et al., 2015).

Within the BMI debate, servitization has been widely considered as an important strategic option for manufacturing firms for the transformation of their business models (Kindström, 2010; Kindström and Kowalkowski, 2014). Specifically, a servitization strategy allows a firm to focus on a more

service-oriented business, logic with the aim of fulfilling customer needs (Kowalkowski et al., 2017). Through servitization, on the one hand, a firm may expand product life cycle up to product performance service (and product-service systems). On the other hand, through servitization a firm can redesign its relationship with its customers in order to increase value related to product support services up to more advanced customer solutions (Kindström & Kowalkowski, 2014) that require cocreation. Hence, there are different elements of the offering related to servitization (in a continuum between product and service) that go from services complementary to products to advanced service (intangible) solutions (Cusumano et al., 2015). Moreover, in this respect, servitization cannot be seen as a unique, integrated transformation process, but have different degrees of complexity and innovation development in relation to the value generation and appropriation (Fliess and Lexutt, 2019; Raddats et al., 2019), where the level of proactiveness and orientation towards innovation is relevant. This may suggest that servitization may occur differently – or not occurring at all – in different strategic types of firms (prospectors, analyzers, defender, reactors).

The literature has discussed the transition of manufacturing firms towards servitization (Fliess and Lexutt, 2019), whereby firms invest in redesigning their offerings in order to exploit new sources of competitive advantage. This service transition can be particularly effective for the enhancement of the value of a firm, its competitiveness within turbulent industries, and in cases of environmental uncertainty and demand volatility (Fang et al., 2008). This transformation is not always successful and a firm may face a servitization failure due to internal organizational problems or solution responses that are not aligned with customers' needs and knowledge, among other problems identified by scholars (Valtakoski, 2017). On the contrary, research suggests that an appropriate organizational structure, customer involvement in service development, and investment in digital technologies are all factors supporting positive servitization strategies (Fliess and Lexutt, 2019).

2.2 Role of digital technologies to support new strategies in turbulent times

The current technological landscape embraces a wide set of technologies that goes from the

Internet-based technologies (i.e. web and social media) to the recent advanced manufacturing technologies and data-management solutions (from cloud to artificial intelligence) falling in the recent fourth industrial revolution, also known as Industry 4.0 (Schwab, 2017). In this view, such scenario expands the possibility of firms to overcoming the challenges related to external crisis such as that generated by the pandemic. Literature has highlighted the relevance of digital technologies during the COVID-19 outbreak as tools that can help SMEs to sustain business continuity and overcome the radical challenges posed by the pandemic (Papadopoulos et al., 2020; Penco et al., 2022). In this sense, recent research suggests that embracing digital technologies and using them to offer online services or even for information-sharing can help businesses thrive in the COVID-19 pandemic (Donthu and Gustafsson, 2020).

While digitization refers to the process of converting analogue data into digital data, digitalization is linked to the exploitation of business opportunities connected to digital technologies (Rachinger et al., 2019). Digitalization may be rooted in a wide set of technologies related to ICT and, more recently, in Industry 4.0 (Chiarini et al., 2020; Frank et al., 2019; Sestino et al., 2020; Thoben et al., 2017). As far as ICT is concerned, websites and social media in particular represent key technologies for customer engagement, whereby the ability to better understand the market and connect with customers has been enhanced by solutions for customer relationship management (CRM) and e-commerce (Chaffey et al., 2019; Sawhney et al., 2005; Siggelkow and Terwiesch, 2019). Moreover, being connected with customers to constantly receive their feedback and monitor their behavior assure a sort of continuous innovation that reduces market uncertainty (D'Angelo and Baroncelli, 2020).

This web-based digital interaction with the market has been deeply enriched by more recent technologies included into the Industry 4.0 framework. In particular, solutions related to Internet of Things (smart connected products) (Iansiti and Lakhani, 2014; Porter and Heppelmann, 2015) and advanced data analytics (McAfee and Brynjolfsson, 2012), or more broadly connected technologies (Lardo et al., 2020), deeply influence strategic and marketing options, not only in B2C but also B2B (Pagani and Pardo, 2017). Adaptation made through online platforms and other web-based

technologies helped entrepreneurs to create new customer relationships and entering in new markets (Shepherd, 2020). Simultaneously, advances in digital technologies, such as cloud, big data analytics, artificial intelligence (AI), Internet of Things (IoT), and virtual/augmented reality enable capabilities for the dynamics of market forces and transmit critical information for autonomous decision making (Lee and Trimi, 2021). We specifically refer to this group of Industry 4.0 technologies because they are able to strengthen a firm's knowledge base for strategic decision making based on advanced data analytics (Davenport, 2020) and define new digital strategies (Sestino et al., 2020) as well as new forms of connection with customers at a distance (Trabucchi and Buganza, 2019). Such technologies can be particularly relevant during times of crisis.

Many scholars underline how diversification and servitization are tightly linked to digitalization (Kohtamäki et al., 2020). Firms may call on digital technologies to improve product and market diversification (Apostolov and Coco, 2021) both in terms of industrial processes (backend digitalization) and commercial processes (frontend digitalization) (Coreynen et al., 2017). From those studies, a clear strategic direction emerges for firms: by investing in digitalizing their business processes – upstream and, above all, downstream – and an effective data management strategy (Rachinger et al., 2019), firms may transform their competitive behavior not only to react to new emerging customer needs, but also to define proactively a new offering within a new business logic (business model innovation interpreted through the service-dominant logic paradigm) (Foss and Saebi, 2017).

The digitalization is a valid solution to maintain market position (in a defensive view) or to improve a company's performance by encouraging products, services and practices innovation and to achieve new market opportunities (Jafari-Sadeghi et al., 2021; Polese et al., 2021) (in a proactive perspective). However, firms and in particular SMEs encounter many difficulties in approaching to digitalization due to their limited resources (e.g. financial and skilled human resources), which represent the main barrier to overcome and this limit has emerged as particularly relevant in times of

crisis such as the COVID-19 pandemic, as firms had to face the new challenges emerged in a very quick time (Klein and Todesco, 2021).

Research on technological adoption in conditions of extreme crisis like the COVID-19 one has demonstrated that firms had been forced to innovate because the traditional ways of working became impossible, thus they have had quickly to use digital technologies to continue their business (Kateb et al., 2022). The time pressure posed by the pandemic spurred creativity and presented opportunities to enable and accelerate innovation and experimentation (Gkeredakis et al., 2021). On the one hand, during COVID-19, as consequence of social distancing and to strengthen the ties with market and consumers, firms, independently from size and industry, increased the use of web-based technologies, such as websites, social media and e-commerce or information systems to develop customer relationship management (CRM) activities (Bettiol et al., 2021; Penco et al., 2021). On the other hand, to better understand new customer needs as well as offer a more engaged customer experience (satisfaction and trust level), firms have started to use the new digital technologies (e.g. AI, big data, IoT) and begun to adapt their business models to compete in a more digitalized world (Margherita et al., 2021; Modgil et al., 2022).

In scenario of turbulent competitive times, digitalization may support diversification and servitization, but can also be a useful tool for managing existing markets – also at distance – opening issues on the ways firms may rely on technologies to support their strategic behaviors to cope with the exogenous crisis.

3. Methodology

To answer to our research questions, we carried out a CAWI-based survey between October and November 2020 addressing the questionnaire to a stratified sample of more than 4,800 Italian SMEs operating in different manufacturing industries (grouped into Low-Medium/low and Medium/high-High technological industry) collecting 257 useful questionnaires. The sample consists of two different groups in terms of economic and financial indicators used by financial institutions to rate

companies (average turnover 2016-2018; average turnover growth 2016-2018 and average ROE 2016-18), specifically the top- performers (coded 1) and the average-performers (coded 0).

The questionnaire focused on assessing the firm's response to the COVID-19 pandemic consists of several sections. In the first section, it aimed at assessing some business variables such as the main client served before and during the pandemic (B2B vs B2C), the change of distribution channels, the comparison between the turnover during the pandemic and the turnover of the same period of 2019 (decreased; stable; increased). Then, the R&D activities have been assessed. It has been assessed the level of R&D during the pandemic (decreased; stable; increased); if R&D allowed to develop new products (yes or no); and if the outputs of R&D have been useful only for the pandemic periods or also to redefine the firm's offering for the post-pandemic period (7-points Likert scale; 1 = completely disagree; 7 = completely agree).

In the second section, as far as BMI is concerned, we assessed the implementation or improvement of servitization during COVID-19 (Rapaccini et al., 2020), assessing the development and offering of a set of services according to the literature above described. Similarly, we consider the firm's diversification strategy evaluating the offering of new products and/or the penetration of new markets. To perform the analyses to outline the strategic behaviours adopted by firms in terms of proactiveness to the crisis, we calculated a "servitization index" and a "diversification index" respectively as the mean of the items of each variable (see Table 1 for details of variable used). Finally, in the last section, we aimed at assessing some strategic variables. Firstly, we aimed at evaluating the customer's needs during pandemic (Donthu and Gustafsson, 2020). Then, we assessed the role of technologies during the COVID-19 pandemic (Priyono et al., 2020). Specifically, taking into consideration the different features of the different sector investigated, we assessed the increased use of two main groups of technologies. The first group refers to five ICT: website, social media, e-commerce, CRM and SCM. The second group regards five Industry 4.0 technologies: big data, cloud, IoT, AI and augmented reality. In addition, we assessed if, during the pandemic, the technologies improved the relationships with customers, suppliers and employees/collaborators and the perceived relevance of technologies

in improving, in the post-pandemic period, the production and value-chain activities as well as the smart working.

Following recent literature about technology use (Agostini and Nosella, 2019), to capture and analyse the most positive behaviours of firms in response to COVID-19 pandemic (value 5-6-7 of the 7-points Likert scale), for the customer needs requested during the pandemic as well as for the use of technologies we proceeded with the “dummification” of the items. In this sense, we created for each one of the items of the variables before mentioned a binary variable attributing the value 0 for the “negative values” of the Likert scale (values 1 to 4) and the value 1 for the “positive values” of the Likert scale (values 5 to 7). In addition, only respect to the “increased use of technologies during the pandemic” we included in the value 0 of the binary variable created also the option “Technology not used”. Table 1 describes the items and the measures of servitization, diversification and the other strategic variables analyzed (customer needs and use of technologies), specifying the items transformed in binary variables, the servitization and diversification indexes and the ICT and Industry 4.0 variables created.

For the research purposes, we employed a two-steps analysis. First, we run a cluster analysis to determine distinct homogenous groups with similar characteristics related to strategic behaviors showed as responses to the COVID-19 challenges (Lorentz et al., 2016). We clustered groups according to their similarity in terms of servitization and diversification strategies. Considering the explorative purposes of the study, we performed a hierarchical cluster analysis (HCA), which determines the adequate number of groups for sample division, using Ward’s method in the clustering process, with the Euclidean distance measure of similarity among respondents (Hair et al., 2010). In the second step, we run, through the Pearson’s Chi-squared standardized measure of association, a comparison analysis regarding all the different variables investigated to understand if the various groups emerged from cluster analysis presented different COVID-19 innovation response patterns (Ross, 2010).

Table 1: Items and measures of strategic variables

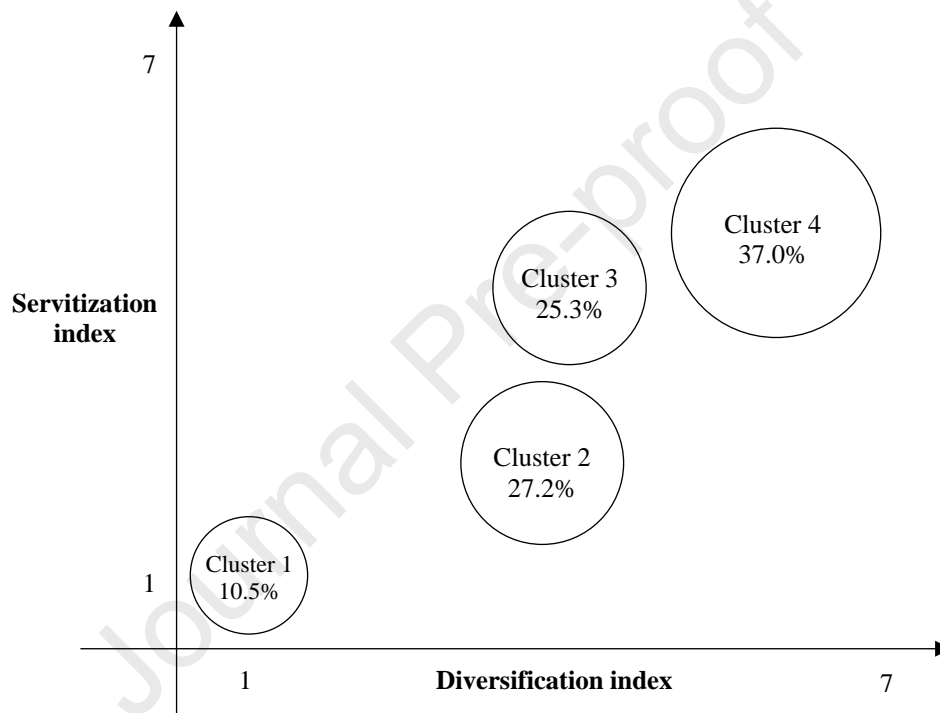
Variable	Items	Measure
Servitization	(1) product customization services (2) pre- and post-sales services (3) complementary product-related services (4) consulting and training services (5) pay-per-use services (6) digital app to support product-use	7-points Likert scale (1 = completely disagree; 7 = completely agree) mean of the six items
Diversification	(1) offering new products in existing markets (2) offering existing products in new markets (3) offering new products in new markets	7-points Likert scale (1 = completely disagree; 7 = completely agree) mean of the three items
Customer needs during the pandemic	Increased demand for customized products/services Increased attention to price Increased attention to sustainability Increased demand for innovative products/solutions	7-points Likert scale (1 = completely disagree; 7 = completely agree) Dummification: 1 = values 5-6-7 of Likert scale, 0 = otherwise
Increased use of technologies during pandemic	(1) website (2) social media (3) e-commerce (4) CMR (5) SCM (6) Cloud computing (7) Big data (8) Artificial intelligence (9) Internet of Things (IoT) (10) Augmented reality Increased use of ICT Increased use of Industry 4.0	7-points Likert scale (1 = completely disagree; 7 = completely agree) plus the option "Technology not used" Dummification: 1 = values 5-6-7 of Likert scale, 0 = otherwise 1 = at least the one positive value of the first group of technologies investigated, 0 = otherwise 1 = at least the one positive value of the second group of technologies investigated, 0 = otherwise
Use of technologies during the pandemic to improve	Relationship with customers Relationship with suppliers Relationship with employees/collaborators	7-points Likert scale (1 = completely disagree; 7 = completely agree) Dummification: 1 = values 5-6-7 of Likert scale, 0 = otherwise
Relevance of technologies in the post-pandemic time	Improve relationships along value chain Improve production processes Developing smart products Transforming sales and distribution processes Smart working	7-points Likert scale (1 = completely disagree; 7 = completely agree) Dummification: 1 = values 5-6-7 of Likert scale, 0 = otherwise

4. Results

HCA allowed to identify different groups with regard to the different levels of servitization and diversification strategies firms implemented during the COVID-19 pandemic. Specifically, similarly

to the Miles and Snow (1978)'s work, HCA grouped the firms of the sample into four distinctive clusters that responded to the COVID-19 challenges in four different ways. As shown in the Figure 1, the clusters are positioned on the chart taking into consideration the group's mean of both servitization and diversification indexes with the circle width related to the size (number of firms) of the cluster.

Figure 1: Clusters emerged



Notes: N = 257.

Cluster 1 (10.5% of the sample) is the “less innovative” with no level of both servitization (group's mean = 1.03) and diversification (group's mean = 1.00) indexes. We defined this cluster as “unresponsive”, because the firms of this group have shown none response towards the external shock. Clusters 2, 3 and 4 show strategic behaviors that can be compared to three groups identified by Miles and Show (1978). Specifically, Cluster 2 (27.2%) groups the “medium-low innovative” firms, with low level of servitization (group's mean = 2.22) and medium level of diversification (group's mean = 3.51) indexes. We defined this cluster as “defender”. Cluster 3 (25.3%) is the

“medium-high” group, with higher level of servitization (group’s mean = 4.00) and medium level of diversification (group’s mean = 3.69) indexes. This group can be defined as “analyzer”. Finally, the Cluster 4 (37.0%) groups firms that have shown the most innovative response to the COVID-19 crisis, high levels of both servitization (group’s mean = 4.36) and diversification (group’s mean = 5.15) indexes. This cluster can be related to the profile of “prospector”, since they show a proactive behavior. From the HCA, two interesting results emerge. Firstly, almost the 90.0% of the firms of the sample has adopted innovation strategies (servitization and/or diversification) to overcome the crisis and sustaining business activities. Moreover, the “most innovative” Cluster 4 (Prospector) is the larger group with 37% of firms that adopted high levels of both diversification and servitization strategies.

Based on the results of the HCA, we have explored the strategic and business characteristics of the four clusters identified to outline differences and similarities across them (Tables 2 and 3). Table 2, concerning the clusters’ business characteristic, shows a significantly difference in terms of performances of the firms belonging to the different clusters, while no differences emerge as far as the industry is concerned. The Prospector group (cluster 4), the most innovative during the pandemic, is mainly composed by top-performers, suggesting how these types of firms may be more prone to innovate the business model through new services as well as to offer new products and explore new markets, consistently with the profile of prospectors described in the literature. Moreover, this cluster is the only one with the highest percentage (20.0%) of firms that during the COVID-19 pandemic increased the turnover. The positive performance achieved could be directly linked to the improving of B2C market (from 7.4% before pandemic to 13.7% after pandemic). Interesting results emerged also with respect to the R&D activity of this group, which resulted to be, respect the others three clusters, functional not only to solve issues emerged from the pandemic, but also for post-pandemic strategies. Clusters 2 and 3 (respectively Defender and Analyzer) are quite similar and show acceptable innovation activates especially for the post-pandemic; instead, the less innovative Cluster 1 (Unresponsive) has shown the poorest R&D activity.

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Table 2: Clusters' business characteristics

Variables	Unresponsive			Defender			Analyzer			Prospector		
	Low-Mlow	Mhigh-High		Low-Mlow	Mhigh-High		Low-Mlow	Mhigh-High		Low-Mlow	Mhigh-High	
Industry-group												
Low-MLow vs Mhigh-High tech industries	51.9%	48.1%		58.6%	41.4%		50.8%	49.2%		37.9%	62.1%	
Performance	Top	Average		Top	Average		Top	Average		Top	Average	
Top- vs Average-performer*	18.5%	81.5%		22.9%	77.1%		30.8%	69.2%		43.2%	56.8%	
Main clients	B2B	B2C		B2B	B2C		B2B	B2C		B2B	B2C	
Before COVID	85.2%	14.8%		90.0%	10.0%		89.2%	10.8%		92.6%	7.4%	
During COVID	85.2%	14.8%		88.6%	11.4%		87.7%	12.3%		86.3%	13.7%	
Distribution channels	Yes	No		Yes	No		Yes	No		Yes	No	
Changed during pandemic	11.1%	88.9%		14.3%	85.7%		6.2%	93.8%		17.9%	82.1%	
Turnover	Decreased	Stable	Increased	Decreased	Stable	Increased	Decreased	Stable	Increased	Decreased	Stable	Increased
Turnover COVID vs Turnover 2019**	59.3%	33.3%	7.4%	61.4%	34.3%	4.3%	60.0%	36.9%	3.1%	56.8%	23.2%	20.0%
R&D	Decreased	Stable	Increased	Decreased	Stable	Increased	Decreased	Stable	Increased	Decreased	Stable	Increased
R&D activity performed during COVID-19	15.4%	69.2%	15.4%	12.5%	72.5%	15.0%	22.6%	61.3%	16.1%	13.6%	57.6%	28.8%
R&D during pandemic	Yes	No		Yes	No		Yes	No		Yes	No	
To Solve COVID issues**	7.7%	92.3%		17.5%	82.5%		19.4%	80.6%		40.9%	59.1%	
Develop new products/services***	0,0%	100,0%		47.5%	52.5%		38.7%	61.3%		72.7%	27.3%	
Useful only for pandemic	7.7%	92.3%		10.0%	90.0%		9.7%	90.3%		16.7%	83.3%	
Useful for redefining offer after pandemic***	30.8%	69.2%		40.0%	60.0%		38.7%	61.3%		83.3%	16.7%	

Notes: *** $p < 0.001$; ** $p < 0.01$.

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Table 3 presents the analysis regarding the strategic variables of this study, highlighting the relevance of customers and technologies for the crisis management paths of higher innovative clusters. In the table, only the positive values are reported in order to have an immediately understanding of differences. The most part of Prospector group (cluster 4) and then also a relevant part of both Defender (cluster 2) and Analyzer (cluster 3), have received from their customers a high demand of customized and innovative products/services and a high attention to price (and moderately also to sustainability). Instead, Unresponsive group (cluster 1) shows the lowest percentage for all customer's need items.

Table 3: Clusters' response paths during COVID-19 pandemic

Variables	Unresponsive	Defender	Analyzer	Prospector
Customer needs during COVID-19				
Higher request customized products/services**	11.1%	37.1%	33.8%	51.6%
Higher attention to price***	14.8%	45.7%	40.0%	58.9%
Higher attention to sustainability***	0.0%	24.3%	20.0%	40.0%
Higher request innovative products/services***	0.0%	45.7%	21.5%	63.2%
Use of technologies during pandemic				
Higher use of ICT***	22.2%	62.9%	44.6%	83.2%
Higher use of I4.0***	25.9%	67.1%	47.7%	85.3%
To improve relationships with customers***	37.0%	41.4%	40.0%	74.7%
To improve relationships with suppliers**	33.3%	41.4%	29.2%	60.0%
To improve relationships with employees/ collaborators **	59.3%	50.0%	44.6%	74.7%
Use of technologies in the post-COVID				
Improve relationships along value chain**	33.3%	47.1%	47.7%	68.4%
Improve management of production processes**	44.4%	50.0%	44.6%	72.6%
Develop of new products**	18.5%	38.6%	49.2%	57.9%
Transform sales and distribution*	37.0%	44.3%	41.5%	63.2%
Smart working	66.7%	57.1%	56.9%	65.3%

Notes: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$. Source: Authors' elaboration.

Respect to the medium innovative clusters (Defender and Analyzer groups), the request of customers during the pandemic have been particularly important for firms focused principally on diversification strategies (Defender group). Such findings outline the key role of customers as source for innovation both in terms of products/markets diversification, especially during the COVID-19 pandemic (Ding and Li, 2021; Li-Ying and Nell., 2020). Prospector group is significantly different

from the other groups and particularly from the Unresponsive one also with regard to the use of technologies during the pandemic and for the post-pandemic period. Prospector firms show the highest percentage (more than 80.0%) of firms that increased the use of technologies during the COVID-19 pandemic, followed by Defender and Analyzer groups. Instead, Unresponsive group shows a very small percentage of firms that increased the use of technologies. Moreover, Prospector group also show a higher percentage of firms that used technologies to improve relationships with customers, suppliers and employees during the pandemic, as well as to improve production processes and value chain relationships and activities in the post-pandemic period. Defender and Analyzer show quite similar results during the pandemic, instead for the post-pandemic, for Defender firms technologies are mainly relevant for the improvement of production processes (mainly linked to product/market diversification), and for Analyzer firms technologies are useful mainly for the development smart products (that may offer a higher level of service). The use of technologies for smart working scope is relevant for all clusters.

5. Discussion and conclusions

The research is one of the first study that aims at exploring how firms strategically answer to exogenous crisis challenging firm's market, by considering in particular the role of both diversification and servitization and identifying multiple strategic behaviors in relations to the firms' proactiveness to innovation and growth . Based on an original sample of Italian SMEs, our study highlights similarities and differences in the patterns of crisis management, discussing how digital technologies and customers are consistent with the response strategies of firms. Moreover, the study provides further knowledge in describing how firms should react to the exogenous crisis events and in turbulent scenarios.

In doing so, we have theoretically considered the seminal work of Miles and Snow (1978) about the strategic responses of firms in terms of adaptation to external changes, such as the exogenous crisis emerged during the COVID-19 pandemic. In addition, to the focus on diversification (products

and markets), our study shed lights on the relevance of also servitization (meant as improvement or introduction of new services) to face the COVID-19 challenges (Rapaccini et al., 2020) taking into consideration also the key role played by digital technologies into a world characterized by “physical limitations” due to the pandemic (Fairlie and Fossen, 2022). The study reveals four main clusters for firms, from the less innovative to the highest innovative, with two medium innovative clusters, one more focused on diversification and the other one that shows also higher levels of servitization strategy. The four clusters emerged can be compared to the four groups identified by Miles and Snow (1978). In particular, three clusters can be compared to the Miles and Snow (1978)’s groups, instead one cluster can be considered differently because it shows different characteristics and, in particular, unresponsive to the COVID-19 pandemic in terms of both diversification and servitization strategies. Indeed, we defined this cluster as Unresponsive, because the firms of this group showed none responses to the crisis emerged during the pandemic. Compared to the Reactor group of Miles and Snow (1978) that had not a clear strategy, the firms of our Unresponsive cluster have not diversified products and markets as well as pushed on services to encounter the new customers and market needs and face the crisis. This behavior, although is adopted by the smallest number of firms of our sample, coupled with a lower use of technologies but also lower requests by customers, could be related to a preexistent critical situation that worsened during the pandemic.

The other three clusters show similarities with the defensive, analyzer and prospector groups identified by Miles and Snow (1978). Indeed, as found by Miles and Snow (1978), both the Defender and Analyzer clusters emerged in this study responded to the COVID-19 challenges trying to sustain sales by diversifying products and markets, with the latter that shows also an adequate emphasis on innovation, here represented by servitization (and innovation of business model). In addition to the previous research, due to the crisis, both groups increased the use of digital technologies to satisfy new customers and market needs. Finally, the Prospector group has shown the most innovative response by stressing both the diversification and servitization through a higher use of digital technologies (both ICT and Industry 4.0). This fourth cluster, as the Prospector’s group of Miles and

Snow (1978), during the pandemic has been innovative and growth oriented, searches for new markets and new growth opportunities.

The comparison among the four groups emerged from the analysis highlights how important is a proactive approach towards innovation at the product and market level (diversification) as well as in terms of BMI (through servitization) for firm' survival during crisis periods. The most innovative cluster (Prospector) has been able to innovate the business model, also shifting among different market types (e.g. from B2B to B2C), offering new products and/or new services to satisfy customers' needs or exploring new market opportunities, sustaining business performance. Innovating during the pandemic offers to the firms the opportunity to manage effectively also the post-pandemic period, for production improvement and products development purposes.

Moreover, the innovation paths emerged during the COVID-19 pandemic relied on customers that can be considered as drivers of innovation in a co-creation perspective (Ke et al., 2022). Indeed, COVID-19 highlighted the relevance of customers' demands in terms of personalized and innovative products/services and a higher attention to sustainability. Customers became a trigger for innovation, also with respect to the BMI. From this point of view, our study emphasizes the competitive weakness of firms that are not able to (pro)actively invest towards the market (as prospectors or analyzers, but also defenders may have).

To reach these emerging "new customers segments" and "new markets" the use of digital technologies is essential. In this sense, during the pandemic, the different innovation paths linked to the four groups showed different levels in terms of technologies use, which has been relevant not only to connect firms with customers, suppliers and employees too, but also to diversify products and markets and to offer new services, even if compared to the diversification strategy, technologies are more important as far as servitization is concerned. The higher innovation (diversification and servitization) the higher is the use of digital technologies. It is interesting to note that between the two medium innovative clusters, the Defender group, with a higher focus on diversification, compared to the Analyzer group, with higher levels of servitization shows higher percentage of firms

that increased the use of digital technologies, but also that used R&D to offer new products also considering the higher percentage of customer request. This could be due to the fact that the latter group (Analyzer) was probably more mature or ready respect to the use of digital technologies for diversification and focused mainly on servitization. Indeed, in this regard, a higher percentage of Defender firms, respect to the Analyzer ones, changed the distribution channels during the pandemic.

COVID-19 forced all types of firms to adapt and reinvent their marketing activities relying on innovation of products, markets and services, through the use of technologies, from ICT to the new Industry 4.0 technologies. Moreover, the pandemic triggered changes in customer behavior, market and supply chains (Sheth, 2020), and digital technologies helped firms and mainly SMEs to face the challenges and, for the more innovative ones, take advantage offered by this “opportunity”. The COVID-19 pandemic, forced firms to innovate and use digital technologies, starting from e-commerce and social media (Penco et al., 2022), particularly important for SMEs as these two technologies are considered relevant means of communication and a way to interact with consumers. This forced adaptation gives to them an opportunity to innovate products and services, reaching new markets and increasing their resilience (Klein et al., 2021; Priyono et al., 2021) showing how important is having a continuous investments in digitalization for firms in times of crisis.

5.1 Theoretical contributions

The study provides empirical evidence regarding the firms’ responses to the COVID-19 challenges, shedding-light on the different innovation paths implemented. Theoretically, the research contributes to enrich seminal Miles and Snow (1978)’s findings, but also existing literature on strategic responses to COVID-19 pandemic (Kateb et al., 2021, Penco et al., 2022) by probing that innovating (through diversification and servitization) during exogenous crisis, such as COVID.19 pandemic, is the better way to face challenges and that firm’s strategic responses during (current) turbulent times depends on both the digital technologies and on interactions with customers, as they can be considered as source of innovation mainly respect to the new market changes.

The way to react to the crisis is to innovate products and services also reaching new markets and new customers segments by innovating business model. Diversification and servitization are the main levers on which firms of all size can rely on to face the challenges emerging (Ke et al., 2022; Kowalkowski et al., 2022). However, during crisis time, new knowledge is necessary to understand the new consumption patterns as well as the new supply–demand relationship, thus, as literature suggests (Papadopoulos et al., 2020), the use of digital technologies allow to manage the changes but also to face them innovating, products, services and markets. Firms that are able to innovate during the crisis are prone to manage discontinuity also in the post-crisis time. New knowledge can help firms to adapt and respond to the new market demands, and this is possible only by using digital technologies to rethink their operations and business models.

Finally, while innovation paths and digital technologies can greatly aid firms in terms of performance, shifting from the offline to online environment, and in searching for new market opportunities (Jafari-Sadeghi et al., 2021), not all firms are prepared to face crisis introducing innovation, in particular SMEs, because not all firms are ready for digitalization.

5.2 Practical implications

Solving problems during a crisis demands speeding up innovation by repurposing the knowledge, resources, and technology you already have at hand (Von Krogh et al., 2020). Research on business models (Teece, 2010) recognizes the relevance of an appropriate strategic analysis to develop sustainable business models, hard to be imitated and on which firm may root its competitive advantage. In case of turbulent competitive, such as that demonstrated by the COVID-19 pandemic firms, should focus on the identification of new sources of value creation (and delivery) and capture, which overcome investing in new products/markets or services to exploit new market opportunities to sustain business and strengthen their competitive advantage. In this regard, the strategic choices for firms should be referred to a business model portfolio, where firms may follow BMI by developing additional business models through servitization through which firms could exploit. Being resilient

and adaptive it is not enough, firms should also utilize the crisis to generate new business opportunities, developing new products/services and/or entering in new markets (Nenonen and Storbacka, 2020). COVID-19 stressed the opportunity to digitize businesses and identify alternative business models through the development and offering of new services that could be useful for firms that are looking to expand their horizons. Moreover, firms that focus their strategy mainly on products/markets diversification should be ready in terms of technological asset during the crisis period if they aim to overcome them.

5.3 Limitations and future research

The study has some limitations that could be thought as hints for the future research. Firstly, the study focused on the COVID-19 as exogenous events and, thus, as empirical setting, while many researches have already studied the implications of the pandemic on firms' behavior. In this perspective, some of the conclusions may be considered limited to the pandemic period reducing the potential generalization of the study, but future research could replicate the research considering new recent political or environmental crisis. This study is based on a quantitative exploratory analysis, while more deep understanding of the strategic paths can be obtained through qualitative research, to assess more in depth the factors that can explain the adoption of a specific strategy as well as the link with the performance. One more limitation regards the multi-industry composition of the sample. Focusing on one sectors or macro-sector could improve the quality of analysis and the definition of the clusters. Furthermore, some limitations relate to the explorative nature of the study. Cause-effect analysis could improve the explanation of the relationships among the different variables and take into consideration business constructs such as the organizational structure of the firm and past strategic orientation that could play a key role in defining the innovative strategic responses and behaviors.

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