DOING BUSINESS UNDER STRESS: THE ROLE OF BIG DATA ANALYTICS CAPABILITY FOR NAVIGATING TOWARDS ORGANIZATIONAL RESILIENCE

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Abstract

The paper aims to investigate if and how the Big Data Analytics Capability (BDAC) enables firms to develop organizational resilience in the face of a crisis. By adopting the Dynamic Capabilities View, the study questions what BDACs influence organizational resilience, and which of these capabilities contribute most to dynamically responding, recovering, and growing in the wake of an adverse event. A multiple linear regression is conducted to investigate the relationship among BDAC and organizational resilience with reference to 192 big data small and medium enterprises (SMEs) in Europe. Research findings support the relationship and significance of BDAC in improving organizational resilience, revealing that intangible and human resources, especially organizational learning and soft skills, play a central role in the crisis recovery. Thus, the cyber resilience is conceptualized as a higher-order dynamic capability. The paper extends the literature on the antecedents of organizational resilience, showing the significant role of the BDAC as key driver in developing the organizational resilience. Finally, we address managers to the exploitation of BDAC in the most effective way to improve organizational resilience and safeguard the competitive advantage threatened by exogenous shocks.

Keywords Big data analytics capability, Organizational resilience, Dynamic Capabilities View, SMEs

Paper type Research paper

1. Introduction

Over the years, natural, social and economic-financial crises have become increasingly frequent and disruptive, all of which having a great impact on both variability of the business landscape and vulnerability of the organizations (Tonby and Woetzel, 2020; Lee and Trimi, 2021). The crisis that developed globally following the spread of the COVID-19 pandemic has significantly adversely hit the economies above the effects seen from other crises (Baker et al., 2020). Under these conditions, a fast recognition of opportunities to recover during and post disruption is strategically important for sustaining the business continuity (Blackburn et al., 2020; Lu et al., 2020).

The ability for firms to rebound is known in the management literature as organizational resilience, which is understood as the capability to anticipate and adjust to the environment, gaining sustained growth and competitive advantage (Ortiz-de-Mandojana and Bansal, 2016; Granig and Hilgarter, 2020). Thus, resilient organizations better manage their vulnerabilities and be more adaptive and innovative in their operations (Aldunce et al., 2014).

Despite the importance of organizational resilience is widely accepted, there is paucity of research about how firms could become resilient. Recently, the crucial role of digitalization in reducing firms' vulnerability has been highlighted: in fact, the adoption of digital technologies enables the efficient use of resources and improves the information processing by helping firms to anticipate, make rapid decisions, and adjust proactively to the adverse events (Joseph and Gaba, 2020; Miceli et al., 2021). In this vein, big data have been considered promising technologies to develop organizational resilience in crisis times. However, little research has been conducted on big data applications in disaster management domain (Sarker et al., 2020). Anyway, a comprehensive understanding of resilience's antecedents is indeed lacking, and the mitigation of the disruptions caused by critical events is thereby hindered (Zhang and Qi, 2021). Moreover, many studies have neglected that resilience calls for developing capabilities to face unexpected environmental turbulences (Sakurai and Chughtai, 2020).

Given these issues, the paper aims to investigate if and how the Big Data Analytics Capability (BDAC) enables firms to develop organizational resilience in the face of a crisis. Theoretical foundation is set on the Dynamic Capabilities View (Teece and Pisano, 1994) that, positioned in a crisis/disaster context, can help to shape/change organizational resources and routines, sense/seize opportunities, and maintain/enhance competitiveness (Teece, 2007; Jiang et al., 2019). Furthermore, DCV is suited to the analysis of the potential of big data as value-creating resource, and also allows the investigation of how big data assets and processes require an endless reconfiguration to effectively fit the knowledge extracted with the various company's needs (Ciampi et al., 2021). Thus, the study questions: Does BDAC influence organizational resilience? and which specific capabilities contribute most to dynamically responding, recovering, and growing in the wake of a crisis?

A regression analysis was conducted to investigate the relationships among BDAC and organizational resilience with reference to 192 big data small and medium enterprises (SMEs) in Europe. These companies are experiencing a huge existential challenge (Blackburn et al., 2020; Lu et al., 2020) exacerbated by the lack in internal resources that increases their vulnerability during the Covid-19 crisis (Del Vecchio et al., 2018). The research confirms the relationship and significance of BDACs in improving organizational resilience.

The contribution of this study is twofold. Primarily, the body of knowledge on the antecedents of organizational resilience is extended by showing the significant role of the BDAC as key driver in developing the organizational resilience. Secondly, we answer the call for future research aimed to identify and assess the opportunities and interlinkages associated with the use of digital technologies for SMEs in the context of COVID-19 (Fitriasari, 2020; Ratnasingam et al., 2020; Liguori and Pittz, 2020; Zutshi et al., 2021). The paper further offers direction to managers who could fail to understand that in a complex scenario the real opportunities for a long-term resilience mainly arise from intangible and human resources of BDAC. In so doing, the conditions enhancing chances of survival when SMEs faced with a critical event are clarified.

The remainder of the paper is structured as follows. To begin, an overview of the theoretical underpinning of the study and hypothesis development are presented. Next, the research methodology employed is described. Later, empirical evidence is reported and lastly, a discussion of the results is presented followed by theoretical and managerial implications, limitations, and future research directions.

2. Theory and hypothesis

2.1 BDAC

The emergence of big data phenomenon represents a new frontier of technological innovation, business opportunities and competitiveness, so that it has become a top matter for both scholars and practitioners (Shan et al., 2019; Elia et al., 2020). In general terms, the big data phenomenon is characterized by an exponential amount of data (volume) that are heterogeneous in nature (variety), generated and transmitted in real-time (velocity) (Constantiou and Kallinikos, 2015; George et al., 2016; Dubey et al., 2021). Of note the presence of accurate and reliable data (veracity) that positively contribute to improve the firm performance (value), and the ongoing variation of data meaning and interpretation (variability) (Seddon and Currie, 2017; Sivarajah et al., 2017).

Beyond the above-mentioned computational and technological infrastructure features (volume, variety, velocity, veracity, value, and variability), the big data phenomenon also comprises aspects related to the management and incorporation of big data into organizational processes (Lozada et al., 2019). In this vein, the BDAC plays an important role to improve efficiency and effectiveness in analysing and processing big data for value creation (Shamim et al., 2020). In particular, the BDAC refers to company's distinctive and inimitable abilities, that is, the continuous exploitation of big data to obtain the strategic insights and develop a competitive advantage for the firm (Garmaki *et al*., 2016; Mikalef et al., 2017). Thus, BDAC is herein considered as a dynamic capability that calls for an ongoing renovation to create value for a company in a changing context (Garmaki et al., 2016; Braganza et al., 2017).

One of the most comprehensive conceptualizations of BDAC construct was designed by Wamba *et al*. (2017) that identified: i) BDA infrastructure flexibility referred to BDA connectivity, compatibility, and modularity; ii) BDA management capability involving BDA planning, control, investments, and coordination. In this regard, literature has added big data experimentation, contextualization, democratization, and execution together with the leadership, talent management, and culture to the BDA management capability, especially for decision-making (Zeng and Glaister, 2017; Shamim et al., 2019); and iii) BDA personal expertise capabilities referred to BDA technical knowledge, technology management capability, business knowledge, and relational knowledge.

According to the paper purposes, we draw upon from literature on resources categories that account for BDAC. In this regard, Gupta and George (2016) identified tangible, human, and intangible resources. In particular, tangible resources are represented by technological and physical infrastructures allowing to integrate, store, process, analyse and visualise internal and external data. Human resources include people with both technical and managerial skills for big data, and intangible resources such as data-driven culture and organizational learning. Finally, intangible resources comprise a diffused data-driven organisational culture and a company orientation to collect, share, stock and apply big data-based knowledge.

2.2 Organizational resilience

Etymologically, resilience comes from the Latin root word *resilire* that means to rebound and implies springing back (Russo and Ciancarini, 2017). This concept originated from natural science that emphasized it as "the persistence of systems and their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables" (Holling, 1973). Since then, the disciplinary reach of resilience has spread across various fields ranging from human psychology (Luthans, 2002), engineering (Hollnagel et al., 2006), and economics (Perrings, 2006). Over the last years, the body of research on resilience has gained new momentum in business and management literature (Clement and Rivera, 2017; DesJardine et al., 2017; Williams et al., 2017). This interest across various disciplines has enlarged the initial relatively narrow focus of resilience by including the capacity of a system to be not only stable but also adaptive. Recently, the concept has been evolving to represent an even transformative capacity by concentrating on non-linear complexity and multidimensional stability of systems (multi-equilibria). According to Lv et al. (2018), stability is understood as the organization's ability to handle large stresses that could cause a loss of function due to disturbances. This ability consists in buffering impacts, absorbing shocks, and returning to a pre-shock situation. Instead, adaptability is referred to the organization that keeps pace with changes and shapes new opportunities thanks to the learning and experimentation. Thus, resilience is the trade-off between stability and adaptability that are interdependent and mutually enabling.

Researchers criticize resilience for being vague and fuzzy, thus reducing its significance for theory and practice and making the field not yet sufficiently mature (Linnenluecke, 2017). A recent literature review on organizational resilience has identified the main reasons for this confusion (Hillmann and Guenther, 2021). First, the concept is defined in many ways: both as single construct (capability, capacity, characteristic, outcome, process, behaviour, strategy or approach, type of performance) and as umbrella construct (mix of the above-mentioned constructs). Second, the studies on resilience are

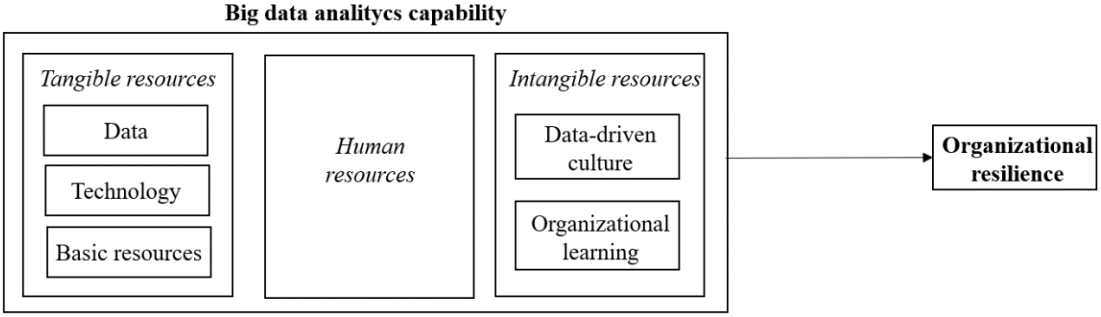
linked to a multitude of phenomena such as unexpected events, disruptive events (terrorism, extreme weather events, data loss, fire) or more general changes (climate change, environmental change). Third, resilience differs between industries and between companies that become resilient according to own resources and capabilities.

In this study, organizational resilience represents a firm-level capability to adapt and/or dynamically relate to its environment (Williams *et al*., 2017; Ciasullo *et al*., 2020). It is multidimensional in nature by embracing the following dimensions (Ramezani and Camarinha-Matos, 2020): i) capacity to rebound from trauma and recover (i.e., stability); ii) capability to maintain a desirable state (i.e., bouncing back to a new equilibrium condition or an accepted state); and iii) capacity to withstand stress with the focus on persistence thresholds (i.e., gradual adaptation and transformation). In sum, a resilient organization will always find "*ways to take chances and take advantage of situations*" (Aldianto *et al*., 2021, p. 3).

2.3 BDAC and organizational resilience: the hypothesized relationship

To help mitigate the effects generated by critical events, recent suggestions from scholars include the shift to the digitalization by highlighting how resilience is boosted by the deployment of digital technologies that increase the speed and effectiveness of linkages between crisis's impact and systemic response (Liguori and Pittz, 2020; Musa and Aifuwa, 2020; Papadopoulos et al., 2020). Hence, big data technologies contribute to predict change and provide the means for enabling flexible business processes, remote collaboration, and real-time connectivity between all stakeholders involved in the value chain, internally and externally (Ashrafi et al., 2019). Furthermore, digital technologies help management to identify possible sources of disruption, so that the emergency preparedness and business continuity can be planned to speed up recovery of the pre-shock situation. In sum, digitalization has the potential to reduce the magnitude and reach of change, also increasing the agility and resilience of the firm (Miceli et al., 2021). Moreover, organizational resilience is also dependent on a set of cognitive, behavioural, emotional, and relational capabilities that companies need to develop in dynamic environments (Williams et al., 2017; Al-Ghattas and Marjanovic, 2021). Hence, as Figure 1 shows, we argue the following hypothesis: *BDAC has a direct and positive effect on organizational resilience.*

Figure 1. Research model



Source: Own elaboration

3. Method

3.1 Sample selection and data collection

Sample was extracted from Crunchbase, a database containing a plethora of daily updated information about innovative companies and startups worldwide in the big data space. Moreover, it has already been successfully utilised for research on entrepreneurship and prior crises (e.g., Block and Sandner, 2009) as well as on the COVID-19 crisis (Brown and Rocha, 2020; Kuckertz, 2021), speaking for its reliability. We extracted European SMEs which have up to 250 employees and an annual turnover of up to 50 million Euros, or a balance sheet of no more than 43 million Euros, and represent the backbone of the European economy, making up 99.8% of all enterprises and two-thirds of employment (European Commission, 2019). In addition, European SMEs have been directly affected by the Covid-19 outbreak on the supply and demand sides alike (OECD, 2020). These aspects make the sample selected an interesting research setting to investigate the organizational resilience in the big data context during the pandemic age. After data cleaning run in January 2021 as a reference point, 715 SMEs, for which information on contacts and industries were available, formed the sample.

3.2 Data collection and analysis

Field work was conducted between February 2021 and May 2021 through an online questionnaire written in English, uploaded onto an online survey platform and applied to the management of the sample firms, especially involving the organizational positions of chief executive officer (CEO), chief information officer (CIO), chief data officer (CDO), chief analytics officer (CAO) general manager, research and development director, human resources manager. The questionnaire was introduced by a brief description of the survey purpose, researchers' identity, and average time required to complete the survey. How the collected data would be used and guarantees of the confidentiality of answers were also specified. It followed three sections consisted of 37 questions. The first section comprised 4 questions useful to define the sample in terms of industry, size, age, and respondent's position. The second section contained 28 questions on BDAC and 1 question on the human skills that highly contribute to the human resources responsiveness to the critical events. The third section had 4 questions, of which 3 questions on organizational resilience, 1 question about the equipment of big data technologies.

Before the full-scale formal survey, a pilot test was conducted involving a convenience sample of 20 executives to assess the response latency and check for correct under-standing of the questions (Lavrakas, 2008). 192 valid questionnaires were returned, representing a response rate of 26.8%.

Collected data were analysed by performing a multiple linear regression, using the ordinary least squares method, one of the most popular techniques for data analysis within the social sciences (Gómez-Bolaños et al., 2019). All the analyses were conducted with the help of SPSS v 22 statistical software.

3.3 Measures

To measure each construct, specific items taken from the literature were used (Appendix A). BDAC was the independent variable of the model measured by using the Gupta and George (2016) scale. The latter is composed of tangibles, human skills, and intangibles constructs. In turn, the

tangibles construct is composed of data, technology, and basic resources as sub-constructs; while the intangibles construct is made up of the following sub-constructs: data-driven culture and intensity of organizational learning. The organizational resilience as dependent variable was captured by adapting Melián-Alzola et al. (2020) scale. In particular, we made minor modifications in wording of the items based on the feedback from pre-tests in order to improve scale performance.

To capture respondent responses on various constructs, all scales were designed in five-point Likert format anchored as 1 (strongly disagree) and 5 (strongly agree) (Malhotra and Grover, 1998).

Both validity and reliability of each measurement scale was verified, as recommended by Jolliffe (2002). The checking of the scale validity and reliability was performed by means of an iterative process. All values were higher than the minimum acceptance threshold with regard to the Kaiser–Meyer–Olkin test (>.5), Bartlett's test of sphericity (Sign. < .005) and Cronbach's alpha (>.70) (Tab. 1).

Table 1. Validity and reliability of the measurement scales

Variables	Validity		Reliability
	Kaiser–Meyer–Olkin test	Bartlett's test of sphericity	Cronbach's alpha
Data	.642	.000	.723
Technology	.754	.000	.882
Basic resources	.604	.000	.876
Human	.581	.001	.716
Data-driven culture	.850	.000	.868
Organizational learning	.660	.000	.841
Organizational resilience	.745	.000	.772

Source: Own elaboration

In addition, we have used firm size as control variable which may influence the exogenous and endogenous variables and may cause unwanted sources of variance. Firm size was measured by coding the employee range based on the number of employees of the firm.

4. Findings

Table 2 shows a description of our sample profile largely including medium firms (48%), recently founded (1-5 years: 27%) and operating in service industry (56%), as revealed by respondents that fill mainly the CDO position (25%).

Table 2. Sample profile

SME's characteristics	Categories	Percentage
Industry	Industrial	44
	Service	56
Size (number of employees)	<10	22
	10-49	30
	50-250	48
Age (years)	1-5	27
	6-10	18
	11-15	16

	16-20	14
	21-25	11
	26-30	9
	>30	5
Respondent's position	CEO	18
	CIO	10
	CDO	25
	CAO	20
	General manager	17
	R&D manager	4
	Human resources manager	6

Source: Own elaboration

Table 3 presents descriptive statistics and correlations for the key variables used. All correlation coefficients are well under 0.7, indicating that there is no serious multicollinearity.

Table 3. Descriptive statistics and correlation matrix

Variables	**M**	**SD**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. Data	6.48	1.33	0.16						
2. Technology	6.75	1.31	0.14	0.12					
3. Basic resources	4.63	1.32	0.19*	0.01	0.15*				
4. Human	4.95	1.20	0.11	0.22**	0.03	0.19*			
5. Data-driven culture	7.06	1.19	0.64***	0.15	0.30	0.07	0.04		
6. Organizational learning	3.75	.62	0.33	0.10	0.06	0.12	0.02	0.15**	
7. Organizational resilience	3.18	2.83	0.17	0.22**	0.01	0.26	0.20*	0.08	0.19*

Notes: M = mean; SD = standard deviation; p < .05. **p < .01. ***p < .001

Source: Own elaboration

To gain further insight, we tested our hypothesis through ordinary least squares regressions (Table 4). To check for possible multicollinearity among our independent variables, we examined the variance inflation factors, all of which were within acceptable ranges. In addition, there were no autocorrelation problems in the research data, as demonstrated by Durbin-Watson (DW) values ranging from 1.5 to 2.5 (Cohen et al., 2003). Empirical results demonstrate that the research hypothesis is supported since all independent variables are significant and positive. In particular, the strongest causal relations concern the variables organizational learning (ß = .852) and human (ß = .846). Conversely, data, technology, and basic resources show the lowest standardized coefficients (respectively ß = .315, ß = .281, and ß = .197). As regards the control variable, size is not significant.

Table 4. Regression results

Variables	**Model 1: Organizational resilience**			
	Standardized coefficients	***T***	***p***	**VIF**
Data	.315	3.747	.000	2.673

Technology	.281	5.864	.002	2.056
Basic resources	.197	5.260	.000	1.586
Human	.846	15.804	.000	1.620
Data-driven culture	.693	6.780	.003	1.409
Organizational learning	.852	3.133	.000	2.944
Size	.137	4.120	.166	/
F 23.863				
Adj. R^2 .546				
DW 2.112				

Source: Own elaboration

5. Discussion

Research findings obtained via regression analysis support the hypothesis generated in our study based on review of managerial and strategic literature, painting an interesting picture of the linkage between BDAC and organizational resilience in SMEs coping with adversities. The empirical evidence has supported the relationship and significance of BDAC in improving organizational resilience, enhancing the known linkage between data analytics and resilience (Papadopoulos et al., 2020) and also confirming the potential benefits of digitalization for recovering from disruptions caused by the COVID-19 pandemic (Rapaccini et al., 2020; Zhang and Qui, 2021).

More in depth, our sample has revealed that intangible and human resources play a central role in building the organisational resilience. Thus, despite big data technologies, with their multitude of platform applications, are considered a promising tool to reduce vulnerability to crises (Sarker et al., 2020), this study has corroborated that the tangible resources are a necessary but not sufficient condition for overcoming the critical events. The nature of systemic crises (Ciasullo et al., 2020) calls indeed for a wider resources' equipment useful to restore strength and resilience in the wake of disruptions. In other words, technology *per se* – mainly including cloud systems, Customer Relationship Management (CRM), Enterprise Resource Planning (ERP), Radio Frequency Identification (RFiD), Geographic Information System (GIS), and wireless sensor network – and does not allow the automatic attainment of resilience: it is only through the adoption of data-driven culture and organizational learning (intangible resources), together with the valorisation of human resources that resilience can be achieved successfully.

Within the intangible resources, the organizational learning mainly affects organizational resilience as suggested by previous studies (Gracey, 2020; Orth and Schuldis, 2021). Thus, one of the keys to the development of resilience at a strategic level is the building of a big data-based situational awareness. The latter refers on the understanding of dynamically changing environment, maximisation of achievable information to turn it into intelligence, and breaking down of knowledge silos regarding the vulnerabilities in which companies could incur. The ease of access to, use and exchange of data and big data analysis results incentivize open and collaborative innovation strategies (Del Vecchio et al., 2018; Urbinati et al., 2018). Hence, organizational learning represents a potential for co-innovation that involves companies, users, customers and other socio-economic actors in the

exchange and integration of resources, ideas and information for cooperatively innovating by reducing time, costs and risks (Lozada et al., 2019; Chen et al., 2020). For these reasons, an opportunity for a faster and easier overcoming of the crisis adverse consequences in SMEs entails their greater propensity for open innovation (Chesbrough, 2020; Paunović and Aničić, 2021).

With reference to the human resources, the soft skills are keystones to enhance organizational resilience. To respond to the challenges of the crises, thus, there are need of the transversal cognitive and meta-cognitive skills such as critical thinking, complex problem solving, creative thinking, learning to learn and self-regulation, together with social and emotional skills such as conscientiousness, responsibility, empathy, self-efficacy and collaboration (OECD, 2019). This set of skills enrich organizations with the necessary variety and expand the space of possible alternatives maintaining or improving the businesses' chances to survive (Barile and Saviano, 2018). Hence, human resources should acquire a T-shaped expertise in which in-depth vertical knowledge in specific fields or disciplines is combined with horizontal capabilities in an attempt to shift between them (Saviano et al., 2017). Thus, the T-shaped profiles are required to face emerging social and economic complexity in the wake of a crisis that, being "sudden, inconceivable, damaging, sensitive, and unique" (Buchanan and Denyer, 2013, p. 205) calls for rethinking the human resources approaches.

According to the evidence above discussed, drawing upon the empirically verified relationship between BDAC and organizational resilience, we consider appropriate the concept of cyber resilience that is framed as a higher-order dynamic capability. It enables the organization to successfully face disasters and reduce vulnerability through interconnected resources of BDAC (mainly intangible and human one) that constitute a gateway for business continuity.

6. Conclusion

The present research contributes to literature by employing an empirical approach, one that also leads to managerial implications and provides some future research directions.

Theoretically, this paper extends previous studies on the antecedents of organizational resilience, finding that BDAC acted as key determinant of organizational resilience during a critical event. Moreover, the body of knowledge on how SMEs cope with adversity is also enhanced by emphasizing some strategic issues of potential of BDAC for overcoming the COVID-19 pandemic impact, while the emerging literature have mainly addressed the role of digital technology as a structural tool. Thus, the study moves away from the main current of analysis focused on big data from a technical or engineering perspective, but rather focuses on delving into the explanation of big data implications as an organizational capability supporting organizational resilience. Moreover, although the adversities call for greater focus on using technologies to enhance SMEs' resilience, we herein underline the essential role played by organizational learning as intangible resources and soft skills as human resources because digital technologies alone are not sufficient to resolve the barriers to the resilience of such companies. Finally, to the authors' knowledge, the paper is the first empirical work that tests the research model in its current forms.

Practically, we address managers to the exploitation of BDAC in the most effective way to improve organizational resilience and safeguard the competitive advantage threatened by exogenous shocks. Additionally, the cyber resilience could contribute to avoid the traps of digitalization that requires large investments in technological infrastructures which may not earn the expected revenue.

Conversely, our research empirically demonstrates that the investments made in BDAC, especially organizational learning and soft skills resources, generate expected returns in terms of firm capability to flex, absorb, adapt and exploit the changes triggered by adverse events. From this perspective, all crises – including COVID-19 – become opportunities to rethink strategies and plans, rather than a state of urgency and total chaos due to the decline of the work, income, and confidence.

The main limitation of the study is related to the generalization of the results for at least three reasons. First, the hypothesis model was tested in a sample of SMEs located in Europe. In future, our research could be replicated on SMEs in non-European developed countries as well as in developing one, also conducting a comparison with large companies. Second, the impact of the crisis varies substantially across industries, and this will require detailed sectoral analyses. Moreover, COVID-19 was chosen as study setting but it is also interesting to verify if minor-scale disturbances influence the firm's response to build resilience. Third, the fast growth rate of technological techniques and the young field of Big Data represent a limitation *per se*.

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Appendix A. Measurement items

Big data analytics capability (Gupta and George, 2016)

Data

•BDA1: We have access to very large, unstructured, or fast-moving data for analysis

•BDA2: We integrate data from multiple internal sources into a data warehouse or mart for easy access

•BDA3: We integrate external data with internal to facilitate high-value analysis of our business environment

Technology

•BDA4: We have explored or adopted parallel computing approaches to big data processing

•BDA5: We have explored or adopted different data visualization tools

•BDA6: We have explored or adopted cloud-based services for processing data and performing analytics

•BDA7: We have explored or adopted open-source software for big data analytics

•BDA8: We have explored or adopted new forms of data bases for storing data

Basic resources

•BDA9: Our big data analytics projects are adequately funded

•BDA10: Our big data analytics projects are given enough time to achieve their objectives

Human skills

•BDA11: We provide big data analytics training to our own employees

•BDA12: We hire new employees that already have the big data analytics skills

•BDA13: Our big data analytics staff has the right skills to accomplish their jobs successfully

•BDA14: Our big data analytics staff has suitable education to fulfill their jobs

•BDA15: Our big data analytics staff holds suitable work experience to accomplish their jobs successfully

•BDA16: Our big data analytics staff is well trained

•BDA17: Our big data analytics managers understand and appreciate the business needs of other functional managers, suppliers, and customers

•BDA18: Our big data analytics managers are able to work with functional managers, suppliers, and customers to determine opportunities that big data might bring to our business

•BDA19: Our big data analytics managers are able to coordinate big data-related activities in ways that support other functional managers, suppliers, and customers •BDA20: Our big data analytics managers are able to anticipate the future business needs of functional managers, suppliers, and customers •BDA21: Our big data analytics managers have a good sense of where to apply big data *Data-driven culture* •BDA22: We base our decisions on data rather than on instinct •BDA23 We continuously assess and improve the business rules in response to insights extracted from data •BDA24: We continuously coach our employees to make decisions based on data *Organizational learning* •BDA25: We are able to search for new and relevant knowledge •BDA26: We are able to acquire new and relevant knowledge •BDA27: We are able to apply relevant knowledge •BDA28: We have made concerted efforts for the exploitation of existing competencies and exploration of new knowledge
Organizational resilience (adapted from Melián-Alzola *et al*., 2020) •OR1: In the face of change, our firm achieves a new organisational equilibrium by adapting to changes in the environment (e.g., offering new products or services, incorporating new technologies, negotiating with key actors) •OR2: In the face of change, our firm recovers and strengthens at a strategic and operational level (e.g., recovering market share, improving its competitive position) • OR3: In the face of change, our firm adapts strategically and operationally to new environmental conditions

Source: Own elaboration