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ORIGINAL RESEARCH

IT Capabilities, Strategic Flexibility and Organizational Resilience in SMEs Post-COVID-19: A Mediating and Moderating Role of Big Data Analytics Capabilities

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Abstract *This research provides a novel progression to the existing research about big data analytics capabilities (BDAC) by investigating and measuring its influence on organizational resilience and strategic flexibility. Toward that end, 400 different SMEs in Saudi Arabia were approached. Data were collected via questionnaire. Results confirm that the ability to handle big data analytics totally mediates the relationship between IT capabilities and strategic flexibility. Big data infrastructure flexibility has a negative effect on strategic flexibility. Big data personal expertise not only negatively affects the relationship between IT capabilities and strategic flexibility but also stimulates and reinforces the relationship between strategic flexibility and organizational resilience. The critical pathway developed and tested the trend to make the organization as an immune system able to make the best of the worst. This implies the urgent need for policymakers and managers to adopt and comprehend the concept of BDAC instead of IT capabilities to define oriented plans specifically formulated for stimulating strategic flexibility and organizational resilience. By adopting the proposed model, SMEs can interact more effectively internally and externally.*

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Introduction

The impact of COVID-19 pandemic is cruel, and it shakes the whole business activity, especially Small and Medium-sized Enterprises (SMEs), with a fatal impact (Lee & Trimi, 2021). In the post-pandemic world, businesses try to use all their possible and available effort to bring back their prosperity (Ufua et al.,et al. 2022; Zutshi et al.,et al. 2021), especially for SMEs in which corresponding outcomes are still relevant to their abilities to strategically cope and react to turn negative crisis effect into opportunities (Kraus et al. 2020; Wenzel et al. 2020). Many actions are required to get benefits (Angeles et al.,et al. 2022; Davidsson et al.,et al. 2020). Specialized researchers on SMEs continually explore ways to help SMEs relaunch themselves. Based on a systematic literature review, Zutshi et al. (2021) identify three main groups dealing with strategic recommendations for SMEs after COVID-19. The first group focuses on the economic impact of the pandemic on small firms (Hoorens et al.,et al. 2020) and how managers can be prepared to cope with an eventual crisis (Jain et al. 2019). The second group focuses on the current impact of pandemic on SMEs with their different impacts (Bartik et al. 2020) as well as the long-term impact of COVID-19 restrictions on survivability (Bartik et al.,et al. 2020). The third and last group treated various topics, such as resilience in SMEs and its relative importance in anticipating, facing and responding to business challenges (Mokline & Ben Abdallah, 2022). In fact, there is an urgent need for empirical research dealing with a systemic approach to building resilience based on specific components and

characteristics of SMEs (Gerald et al.,et al. 2020; Hadi et al.,et al. 2020; Martinez-Lozada & Espinosa, 2020) to maintain productivity and resolve financial difficulties (Nyanga & Zirima, 2020).

Organizational resilience is considered the first and ultimate option to survive in a turbulent and uncertain environment (Duchek, 2020; Mallak & Yildiz, 2016; Utz, 2020). It can be considered as a proactive attribute (Conz et al. 2017; Ragmoun & Almoshaigeh, 2020), absorptive - adaptative capability (Gray & Jones, 2016), reactive attribute (Branicki et al. 2018) or a dynamic attribute (Asamoah et al. 2020; Halkos and Skouloudis, 2019), which is developed before the event (or crisis) and occurs during the event and after the event. Independently, there is a consensus that is proactively thinking about organizational resilience is still the only best way to survive and face future and present crises in such a turbulent environment (Gorjian Khanzad & Gooyabadi, 2021; Mokline & Ben Abdallah, 2021; Settembre-Blundo et al. 2021).

Proportionally, being resilient for SMEs, especially during and after COVID-19, represent a great challenge due to their limited internal resources compared to large organizations (Del Vecchio et al. 2018). In fact, many factors inhibit the development of organizational resilience for SMEs such as the in adequation of staff training, weak planning, and inconsistent relationships between control mechanisms, management and operating units also can cause a low ability to scan the general context, all of this reduces SMEs' capacity to change and to react to changes in turbulent environments (Figueiredo et al. 2020).

Previous studies have pointed out some determinants of new practices to manage environmental uncertainty and change (Chesbrough, 2020), such as stakeholders' involvement, co-creation activities, acquisition of dynamic capabilities or establishment of inter-organizational knowledge exchanges. However, the definition of principal key levers that generate a continuous adaptation and support resilience is still changing in the context of SMEs (Gorjian Khanzad & Gooyabadi, 2021).

In this line of ideas, Martinez-Lozada and Espinosa (2020) argue that there is a need for additional empirical studies to understand and deal with different relationships between specific components to generate asset resilience in SMEs according to a systemic approach. Also, the emerging literature on resilience for SMEs is still limited and lacks knowledge about identifying an appropriate set of strategic responses to survive during and post-pandemic (Fitriasari, 2020; Liguori & Pittz, 2020). A critical and pragmatic pathway for resilience in SMEs is still inexistent.

Therefore, this research aims to fill this gap identified in previous studies and enrich knowledge in this field of organizational resilience by investigating and appreciating the impact of IT capability on organizational resilience while examining the mediating and moderating effect of big data analytics capabilities (BDAC) on strategic flexibility as determinants of organizational resilience. The research also outlines the critical and pragmatic setting for OR enabled by different factors according to an integrative and dynamic approach to shaping organizational resilience.

The research's purpose is important, and its contribution depends on the critical importance of SMEs on economic structure in different countries across the globe as a stimulator for socioeconomic development at global and local levels (OECD, 2017). Concretely, the paper clarifies, defines and appreciates conditions that enhance SMEs' chances to survive based on a dynamic capability approach (DC). On the one hand, the theoretical paradigm of DC, as defined by Teece and Pisano (1994), can facilitate an understanding of how organizations acquire competitive capabilities by adopting new technologies, such as big data analytics capabilities (Ragmoun, 2022). Therefore, we answer the urgent call for future and additional research on the opportunities associated with using digital technologies for SMEs and their benefits in this case (Ragmoun and Alwehabie, 2020; Zutshi et al. 2021). On the other hand, under such conditions, strategic flexibility seems important and can maintain survival. It is admitted that organizations which adopt strategic flexibility may stay resilient and agile during turbulent moments (Uzoma Ebubechukwu and Edwinah, 2022). Resilient organizations should be able to inculcate flexibility when defining their strategy to adapt to change and to move ahead. Shimizu and Hitt (2004) state that strategic flexibility signifies identifying the most important environmental shifts and responding immediately to those changes using actual resources to define a new course of action.

In this sense, strategic flexibility represents an organizational capability allowing a quick understanding of what is happening to move quickly and respond to the environment using the most opportune sources (Dehghan-Dehnavi and Nadafi, 2010). In this context, Information and communication technology (ICT) can make the collecting data process easier for managers and policymakers to gather efficiently and quickly data, but, with the greater amount of data needed for a decision, analyzing, managing and using information seem to be not easy and big data analytics becomes more appropriate (Jum'a et al. 2022).

According to the research question dealing with how SMEs can maintain and develop resilience when faced with a crisis, a mediating analysis was conducted to measure and investigate the interrelationships among IT capabilities, BDAC and strategic flexibility. A moderating analysis using BDAC was also adopted to identify how adopting such capabilities can reinforce or slow down the development of resilience capabilities. Firstly, the present research has developed a theoretical framework for studying and

testing the association between information technology capabilities (ITC), BDAC, strategic flexibility and organizational resilience. This integrative approach has not been evaluated in previous literary articles dealing with their effects on SMEs via a dynamic capabilities perspective. Secondly, this research expressively seeks to enrich IT literature by defining guidelines for OR on SMEs, especially in such turbulent environments and avoid the negative scenario of COVID-19. Thirdly, this research assists information technology managers in mater OR with its different dynamic aspects and capabilities within their organizations and from empirical perspectives.

Based on the above, research prevents answering three main questions related to OR via BDAC on SMEs:

1. Is there an eventual direct relationship between ITC and OR?
2. Is there an eventual direct relationship between ITC and strategic flexibility using BDAC?
3. Does BDAC moderate the effect of strategic flexibility on OR?

This means that the proposed model comprises two main loops: The first deals with a mediating effect of BDAC, and the second is related to the moderating effect of this variable to amplify and stimulate the development of OR on SMEs.

The manuscript is organized as follows. The authors define the theoretical perspective and detail the literature in the first section of the manuscript. Then, the literature on four main variables, IT capabilities, big data analytics capabilities, strategic flexibility and organizational resilience, are discussed in the second section. Consequently, Sect. 3 deals with hypotheses construction based on the existent literature. Section 4 presents methodology and data collecting process. Before concluding in Sect. 6, the findings are discussed in terms of theoretical and empirical implications added to limitations in Sect. 5.

Theoretical Background

A Dynamic Capability View on SMEs

Capability-based View of Resilience

In this research, the main objective remains the definition of a pragmatic and operational way to achieve and define resilience. As mentioned in the beginning, there is a consensus according to which how and to what resilience can be designed remains unclear (Ulz et al.,et al. 2020). For this purpose, it is admitted that resilience is represented by a dynamic interaction between environment and organization (Williams et al.,et al. 2017). It is not a curative process adopted if needed but a preventive one, and resilience capabilities are associated with a toolkit available for organization survival if needed. It must be developed, maintained, managed and updated. The adoption of such an approach seems to be more operational.

Resilience is considered a meta-capability (Duchek, 2020) that depends on organizational capabilities. Such a conception allows us to underline the dynamism of resilience (Burnard & Bhamra, 2011) pressed by the dynamic interaction of organization (internal) with the environment (external) to identify and adapt to changes and be more flexible. Although, as a meta-competence, resilience is represented first as a process of three main stages, the interconnection and the continuity between them require information flow. Second, it considers the internal working of merged, associated and combined capabilities to develop resilience. IT capabilities regain importance in this state because it facilitates communication, integration and alignment of capabilities and resources (Bharadwaj, 2000).

Organizational Resilience (OR)

Organizational resilience is, at the same time, an ability to adapt and respond (Distel, 2017; Kahn et al.,et al. 2018), a capacity to react adequately to unexpected events or threats to survive (Lengnick-Hall et al.,et al. 2011; Ortiz-de-Mandojana & Bansal, 2016) and a meta-capability (Duchek, 2020). Despite its importance, supported by most studies, there is little consensus on its essence (Utz, 2020) and its determinants. To summarize these different conceptions, we can refer to the dimensions enumerated by Ramezani and Camarinha-Matos (2020). They assimilate resilience into an umbrella, which contains the same time: the capacity to rebound and recover, the capability to sustain a desirable and positive state and the capacity to focus on persistence.

Resilient organizations can always take advantage and chances under any circumstances (Aldianto et al. 2021). Translated to our context of research (SMEs), resilience will be considered a successful adaptation to maintain business by generating, acquiring and combining external and internal knowledge as resources to explore, perceive and adopt rapid changes in its environments. Drawing from these investigations, resilience can be considered a dynamic capability that guarantees that it can respond effectively and rapidly to environmental change and define in three dimensions or three main capabilities: anticipation, coping and adaptation capabilities (Duchek, 2020). Given the variety of existent theoretical perspectives on resilience, the authors chose these aspects that are commonly shared and respond to the main objective of the research.

Strategic Flexibility (SF)

With reference to Holweg (2005), flexibility represents the capacity to adapt to external and/or internal stimuli. Escrig-Tena et al. (2011) associate flexibility with the capacity to respond effectively and quickly to different challenges to satisfy environmental changes and demands. For Osita-Ejikeme and Amah (2022), flexibility is an innate ability to rethink and rearrange to accommodate and adapt to the environment successfully.

Strategic flexibility (SF) is recognizing and accepting environmental dynamics to define new effective responses to these dynamics (external/ internal) (Dehghan-Dehnavi and Nadafi, 2010). For Zahra et al. (2008), strategic flexibility is the degree of change a business can adopt to adjust its strategy according to opportunities, changes and external threats (Zahra et al. 2008). The association between proactivity and reactivity deserves our attention because we must remember here that SF outmoded a simple reaction to prevent subsequent action and reduce risks. In this sense, strategic flexibility can be considered one of the most determinant critical assets of a successful organization by maintaining competitive advantage (Arshad et al. 2018; Johnson et al. 2003; Xiu et al. 2017), establishing success (Wadstrom, 2019; Xiu et al. 2017), surpassing inactiveness (Zhou & Wu, 2010), reallocating resources as needed and required (Sanchez, 1995) to bring creativity and innovation (Li et al. 2010). All of these will positively affect organizational performance (Brozovic, 2016).

Information Technology Capabilities (ITC)

IT capabilities are defined as the ability to use and explore IT-based resources combined with other capabilities and resources to enhance a variety of key performance indicators (Bharadwaj, 2000). Other researchers consider that ITCs are the ability to implement a set of a variety of common platforms and manage them (Lu & Ramamurthy, 2011). There is consensus on which ITCs are developed and adopted to process, collect, retrieve and store information (Basheer et al.,et al. 2016; Galliers et al.,et al. 2020; Zhen and Hu, 2008).

Three main dimensions of IT capabilities are detailed in the existing literature: IT infrastructure capability (ITIC), proactive IT capability (PITC) and capability to align IT (AITC) (Lu & Ramamurthy, 2011). Information technology infrastructure capability represents the base to share and process information. It is a collection of human and technical services coordinated and budged by the management (Weill & Ross, 2004). This capability is directedly related to operational processes, such as company applications and sharing services and products in different locations, to take advantage of eventual synergetic opportunities on business lines (Bharadwaj, 2000; Lioukas et al. 2016).

The IT alignment capability supports the integrative processes between IT and other functional departments. This can help organizations to exploit and visualize IT resources that can contribute to achieving organizational strategic objectives. All this process is based on managing and planning using technological architectures to face future and current challenges (Bharadwaj, 2000; Chen & Tsou, 2012; Wade & Hulland, 2004). Proactive IT capability is related to exploring technological resources to maximize business opportunities created in the market (Cepeda & Arias-Pérez, 2018). This enables organizations to anticipate new trends raised from technological developments and to exploit all opportunities created by emerging technologies (Weill & Ross, 2004). With proactive IT, the organization can operate and establish innovations through quick restructuring and reconfiguration of functional processes (Agarwal & Sambamurthy, 2002; Lu & Ramamurthy, 2011).

Big Data Analytics Capability (BDAC)

Recently, Big data as a concept has been at the forefront of most recent discussions in management research (Lombardi, 2019). It permits the broad manipulation of a significant amount of data. It offers a heterogeneous and large amount of information that it simply approaches (Yin & Kaynak, 2015) and is distinct in terms of volume, value, variety, velocity and veracity (5 V) (Wamba et al.,et al. 2017).

This research focuses on the analytical capabilities of big data that focus on the incorporation and management of big data rather than on its technological and computational infrastructure aspects (Gandomi & Haider, 2015; Lozada et al. 2019). BDA capability refers to an organizational management's ability to deploy and use big data resources for strategic aims, develop competitive advantage and create value (AlNuaimi et al. 2021; Wamba et al. 2017). The existing literature identifies three main axes of BDAC (managerial, personal and infrastructure), such as tangible and intangible (Gupta & George, 2016). Tangible is related to infrastructure and resources, as well as human resources represented by managerial and technical skills for big data. Intangible resources include organizational learning and a data-driven culture (Gupta & George, 2016).

At the same time, BDA is technology, application, practices, methodology and techniques, with the ultimate objective of treating and analyzing data to make the decision (Gandomi & Haider, 2015). Rialti et al. (2020) argue that BD management capabilities fix the right BDA infrastructure, execution, and selection. Provost and Fawcett (2013) explain that the decision-maker must use

specific skills to extract the best technical solution and manage information. This mechanism can stimulate strategic flexibility and resilience because it guarantees adaptability and survival.

BDA personnel are considered essential to the organization despite its position on the organizational hierarchy (Rialti et al. 2020). It is provided by analytic skills related to the data collection and treatment to maintain integrity while changing or adapting (Wamba et al. 2017) and is still relevant to scientific, analytic, and architectural skills dealing with technological infrastructure and datasets (De Mauro et al. 2018).

BDA infrastructures represent technical Information system (IS) available and used to collect, store, process, and analyze big data with its different types to facilitate data flow in every situation (Wamba et al. 2017). It is supposed that this capability is flexible because it should be adaptative to handle much more data or storage capacity (Wang et al. 2018).

Hypotheses Development

The Mediation Role of BDA Capabilities

IT Capabilities and BDAC

GUPTA and George (2016) identified some specific factors for the development of BDAC qualified as tangible and intangible. In this state, technical skills are considered a tangible human resource to build BD, defined as specific know-how to use new and emerging forms of technology to explore and extract intelligence from BD. As defined at the beginning of this paper, IT capability refers to an organizational ability to deploy and mobilize IT resources combined with other capabilities and resources (Bharadwaj, 2000). The literature presents BDA as a new generation of architectures and technologies conceived to economically extract added value through a large volume of data (Mikalef et al.,et al. 2018).

Based on Resources Based View (RBV) and recent studies on BDA, BDAC can be defined as an organizational ability to deploy technology (Mikalef et al. 2020). On a practical level, IT strategists are frequently admitted to being concerned with the availability and quality of the data analyzed (Brinkhues et al. 2014). If data, traditionally provided by IT and managed by ITC, are a core resource, it will be important to provide an infrastructure able to store, share and analyze data (Mikalef et al. 2020). Besides, this can be guaranteed by using BDAC.

Some research considers BD novel technologies that are able to handle many fast-moving and diverse data (GUPTA & George, 2016). Therefore, BDA is derived from IT resources (Agrawal, 2013), which are uncertain about the adoption and application of BDA (Rahman and Zhao, 2020). Based on this brief analysis, the interdependence can be admitted between ITC and BDAC on theoretical and empirical levels.

H1 IT capacities have a positive impact on big data analytics capacity.

IT Capacities and Strategic Flexibility

Strategic flexibility can be defined as the ability to respond to uncertainties based on skills and information for continual development (Eryesil et al. 2015). When there is information, we will need information technologies to collect it. Chen et al. (2017) support that IT is a determinant element of strategic flexibility. It permits the organization to be automatized and improve its operational efficiency (Bhatt & Grover, 2005). IT associated with strategic flexibility ensures not only an operational and tactical impact (Chen et al.,et al. 2017) but also an instrumental role in supporting strategy and the organization's relationships with its partners and customers (Bharadwaj et al.,et al. 2013). Through the development of computing capacity and information processes, IT can assist the organization in entering new markets and satisfying consumers rapidly and adequately.

With reference to the different dimensions of ITC detailed below, it is admitted that IT alignment refinement strategies seem important for profitability and competitive advantage (Aydıner et al. 2018) and for avoiding wasted resources (Ravishankar et al. 2011). With IT, coordination and knowledge acquisition becomes easier and more reliable. IT capabilities as an ability can help managers assimilate knowledge developed via information and, consequently, be able to survive (Grover & Saeed, 2007).

IT, in the organization, provides analytics and information to help them innovate and enter new markets (Chen et al. 2017). It increases coordination and assists in the dissemination of operational information between organizations and suppliers with efficiency (Kotabe et al. 2011). IT can also enhance collaborative spirit among all organization units to support R&D and respond effectively and rapidly to customer's needs (Nabeel-Rehman & Nazri, 2019).

H2 IT capacities have a positive impact on strategic flexibility.

BDAC, Strategic Flexibility, and IT Capacities

WAMBA et al. (2017) argue that BDA is associated with strategic flexibility and impact organization. This contribution can be represented by its capacity to enable and

support the capacity of managers to monitor data use and its related process to plan performance and workflow appropriately (Akter et al.,et al. 2016). Using BDA, an organization can monitor not only competitors as a determinant of their performance and operations (Erevelles et al.,et al. 2016) but behavioral customer patterns are also analyzed and managed in real time, on different levels (Hofacker et al.,et al. 2016). Overall, the majority of emerging research on BDA agrees that, as an analytic tool, it assures coordination between many large socio-economic databases (George et al.,et al. 2014) and permits the organization to navigate, manage and adapt to the business environment (Wamba et al.,et al. 2017) being more dynamic and reactive to change to enhance agility, market responsiveness and dynamic capabilities (Rialti et al.,et al. 2020; Ryabchikov & Ryabchikova, 2022).

Wamba and Mishra (2017) demonstrate that BDA is also analytically related to the capacity to analyze reality or existence and automatic to reduce the time allocated to decision-making and adaptative. In addition, ITC helps identify weaknesses and strengths of business strategy (Awamleh & Ertugan, 2021; Rajesh, 2017). Enabling ITC makes sense of what is happening in an external environment to define the appropriate process based on incoming to improve the external and internal environment (Chu et al. 2019). Also, IT capability literature admits that the ability to deploy and mobilize IT resources distinguishes an organization from its competitors and is considered a source of competitive advantage (Ravichandran & Lertwongsatien, 2005). Undependably, Awwad et al. (2022) demonstrate that IT capabilities positively and significantly affect organizational agility via a dynamic capability approach. An additional need for strategic flexibility requires more internal and/or external information; BDAC seems to be more appropriate to deal with a significant amount of information in real time to unsure flexibility.

H3 Big data capability mediates the impact of IT capacities on strategic flexibility.

The Moderation Role of BDA Capabilities

The capacity of an organization to change technology and adapt consumer orientation with dynamism according to environmental demands determines its ability to predict continuous, systematic and rapid evolutionary adaptation to maintain and gain competitive advantage and survive (Onyokoko & Needorn, 2021). The adoption of integrated platforms, which are a form of BDA, contributes to providing means and forecast change for efficient and effective organizational responses by stimulating the development of flexible processes, the definition of real-time connectivity, and collaboration between all external and internal stakeholders (Ashrafi et al.,et al. 2019; Xie et al.,et al. 2022). O'Leary (2013) supports that big data provide a considerable and enormous amount of data that can be unstructured or structured but also available immediately, every time, and everywhere. This largely meets our needs for resilience. In this case, the generated data are distinctive, generated with speed and characterized by their dimensions and potential to provide valuable information (Wamba et al.,et al. 2017). Consequently, this huge amount of information flow in big data makes the decision more real, based on facts and evidence rather than a simple managerial intuition (Ferraris et al.,et al. 2019; Rialti et al.,et al. 2020), to generate flexibility.

Proportionally, many scholars have recently supported that Big Data (BD) is one of the main sources of competitive advantage and performance (Côrte-Real et al. 2016; LaValle et al. 2011; Morabito, 2015). By managing and collecting determinant and efficient market-related information, big data support opportunities to fit customer needs and sustain competitive advantage (Côrte-Real et al. 2016). The process of adopting Big Data Analytics (BDA) provides resilience and has become more and more determinant. It is the best alternative to traditional information systems, which can limit resilience due to their rigid structure, as admitted by previous research (Ciampi et al. 2018).

Nabeel-Rehman and Nazri (2019) demonstrate that heavy investment in IT capabilities contributes to the sustainability of the firm's competitive advantage, improving information and knowledge flow in organization and inter-organization. Rathina et al (2019) argue that resilience depends on the awareness of factors and resources that can impact organizations. Mohamed and Singh (2012) demonstrate that IT is fundamental to sustaining, growing and supporting business. Mazini (2014) insists on the relative importance of aligning strategic objectives, information and technological resources to face adversity and controlling data and information to assist decision-making.

In a recent report published by the World Bank (2019), ICT is considered a critical factor for resilience based on the development of a specific framework to manage disasters in Japan in two areas: Disaster Information Management System (DIMS) and Early Warning System (EWS). In conclusion, this report presents ICT as a solution to resilience and invites practitioners from other countries to find the best way to explore ICT for resilience. In this state, it must be remembered that BDAC is an advanced version of ITC, providing different kinds of information with significant volume and realism.

H4 Big data capability moderates the link between strategic flexibility and organizational resilience capacities.

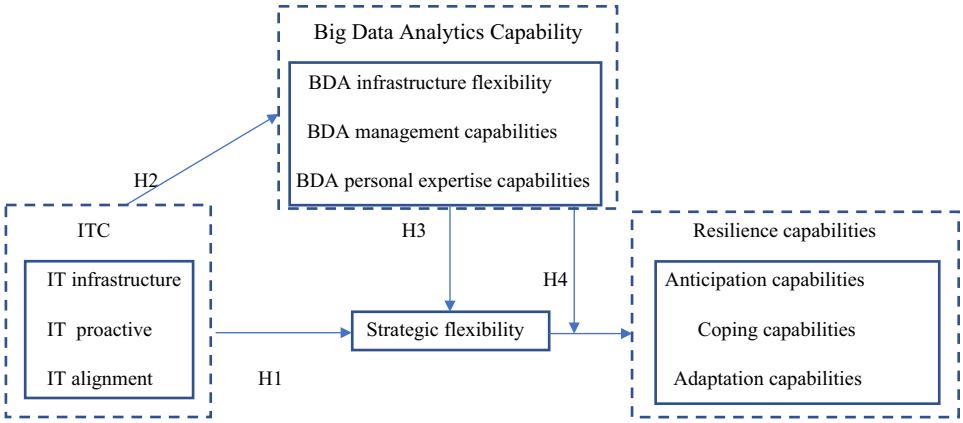

Fig. 1 Research model

The research model represented in Fig. 1 shows that Big Data Analytics capabilities created from IT capacities (alignment and integration) positively impact strategic flexibility. The model also shows a moderating effect of BDAC between strategic flexibility and resilience because it is supposed that more reliable and valid information at the right time (or specifically in the brief time) can accelerate the reaction process to guarantee the adequacy between SF and resilience. So, the organization can adapt and survive appropriately (within its strategic goals). As shown in Fig. 1, BDAC is appreciated in three dimensions, IT capabilities in two dimensions and resilience capabilities in three dimensions. Each dimension can ensure a specific role in developing resilience capabilities. The authors adopted such a subdivision of concept to break down in detail the underlying mechanism for resilience and bring clear responses to its mystery.

Methodology

Procedure and Sample

To collect data, a questionnaire was performed and sent by e-mail due to the need for social distancing imposed by COVID-19. A list of industrial firms in Riyadh and Qassim was selected based on data extracted from https://modon.gov.sa/. The authors tried to resend the e-mail as needed to get the answer. This process took two months. Four hun dred responses were collected, representing 85% of the total questionnaires. The e-mail was addressed to HRM direction, general managers or the IT department. A ran dom sample technique was adopted to select SMEs object of the research. According to previous specialized research in structural equation modeling, the appropriate range of the adequate sample size is from 30 to 460 to be mean ingful compared to the number of associations between sample size and parameters (Hoyle & Gottfredson, 2015). The definition of sample size when using SEM depends on many factors such as model complexity, normality and missing patterns (Wolf et al.,et al. 2013a, 2013b). But, the majority of researcher recommend at least 200 which means 5 or 10 cases per parameters (Kline, 2011). In our case, 10 parameters are tested.

Most recent studies recommend that small sample sizes are enough. It can be ranged from 30 (four indicators or latent variables and loadings level around 0.80) up to 350 for mediating model (Sideridis et al. 2014; wolf et al. 2013a, 2013b). According to Kline (2011), a typical sample size when using SEM is about 200 cases. So, we can admit that the size adopted here can be representative.

Measurement Instruments

The scales used were extracted from existing literature. In cases where scales are unavailable, the authors use dimensions, descriptions or domains provided in previous studies to establish scales. Appendix A is used to summarize the adopted scales and supporting literature.

To measure the construct of IT capabilities, the researchers adopted two dimensions: IT integration and IT alignment. Four items were used to measure IT integration adopted from the scale developed by Rai and Tang (2010), which insists on partners' relative importance in data and information. The dimension of IT business alignment was appreciated by five items from the works of Kearns and Lederer (2003) and oriented planification on both internal and external. Strategic flexibility was assessed on a six-item scale defined by Zhou and Wu (2010).

Resilience capabilities were measured by five items extracted from previous research and considered the most common indicators for resilience capacity as a variable (Lengnick-Hall et al. 2011; Siebert & Gaskin, 2006; Sila, 2007): employee empowerment (EE), employee resilience training (ERT), employee involvement (EI), employee capacity to adapt changes (ECC) and teamwork employee

Table 1 Descriptive statistics

Factors	Proportion of the sample (N = 400) (%)
Business industry sector	
Construction industry	38.5
Energy industry	32
Pharmaceutic industry	10
Food Industry	12.5
Manufacturing industry	7
Profile	
HRM direction	42.2
General manager	11.5
IT department	28.2
Others	9.8
Non-specified	8.2
IS size	
< 50	42
51–70	39.2
71–90	8.8
91–110	5.8
111–200	4.2

capacity (TEC). It is argued that an organization is less or more resilient depending on its internal capacity to treat, analyze and make a decision as needed and communicated by the external environment.

The main scale of BDAC within the existing literature considers it as a multidimensional concept appreciated through three main dimensions as defined by Wamba et al. (2017) in their BDAC model developed based on information technology and information system through the resource-based view.

The present research adopted the scale developed by Ramadan et al. (2020) because it fits the main research interest and corresponds to the definition of BDAC adopted in this case. It is a composite scale extracted from different research. Four items are presented; each represents the most commune aspect mentioned in the existent literature (Kim et al. 2012; Upadhyay et al. 2020; Wamba et al. 2017).

The majority of indicators were appreciated by a Likert scale ranging between 1 and 7 (1 = disagree completely and 7 = agree completely). The complete instrument is presented in Appendix A.

The constructed survey was pre-tested with 15 respondents from faculty members and doctoral students. Feedback was used to refine items if needed, and corrections were made according to different recommendations in the instrument.

Analytical Tools

Structural equation modeling using AMOS 24 was employed to interpret and analyze the proposed model among the research variables (IT capabilities, BDAC, strategic flexibility and organizational resilience). This choice is related to this function's ability to estimate, specify, validate and assist the research model. Initially, the goodness of fit was appreciated via the validation and development of the associations among corresponding observable variables as well as heir measurement (indicators and factors). Consequently, data were submitted to the structural equation modeling (SEM) to examine and appreciate interrelations among different endogenous variables after the descriptive statistics used to identify general charachteristics of our sample (Table 1).

Data Analysis and Results

Confirmatory Factor Analysis

As a first step, the scale was validated based on a factor analysis by SPSS 16. For each construct, the authors tested the loadings and reliability. The convergent and discriminant validity were calculated too. An adequate convergent

Table 2 Validation of scales and descriptive analysis

Constructs and loadings [a]	Number of items	Means	SD	ICR	1	2	3	4	5	6
IT capabilities	9	4.981	1.231	0.811	**0.843**					
Big data analytics management capabilities	4	4.654	1.266	0.975	0.232	**0.765**				
Big data analytics infrastructure flexible capabilities	3	4.214	1.376	0.884	0.254	0.354	**0.750**			
Big data analytics personal capabilities	4	4.132	1.054	0.876	0.228	0.378	0.434	**0.876**		
Strategic Flexibility	6	4.665	1.298	0.966	0.298	0.401	0.399	0.334	**0.771**	
Resilience capabilities	6	4.287	1.116	0.877	0.266	0.411	0.433	0.441	0.601	**0.813**

[a]The significance of the item loadings was assessed using bootstrapping. The t values for all item loadings were significant, at least at the $p < 0.001$ level

Table 3 Loadings and weights

Latent variables	Dimensions	Items	Weights	Loadings	T-value	KMO
IT capabilities	IT integration	ITI1	1.00	1.00	–	0.66
		ITI2	0.344	0.701	58.443	
		ITI3	0.401	0.676	38.676	
		ITI4	0.422	0.649	24.667	
	IT alignment	ITA1	1.00	1.00	–	0.69
		ITA2	0.377	0.562	13.342	
		ITA3	0.398	0.642	12.568	
		ITA4	0.378	0.589	11.564	
		ITA5	0.403	0.679	9.766	
Big data analytics capabilities	BDA management capabilities	BDAM1	1.00	1.00	–	0.84
		BDAM2	0.278	0.766	16.876	
		BDAM3	0.289	0.707	15.433	
		BDAM4	0.302	0.728	15.401	
	BDA infrastructure flexible capabilities	BDAI1	1.00	1.00	–	0.89
		BDAI2	0.377	0.758	22.453	
		BDAI3	0.387	0.774	21.657	
				0.546	8.772	
	BDA personal expertise capabilities	BDAC1	1.00	1.00	–	0.85
		BDAC2	0.661	0.728	11.767	
		BDAC3	0.650	0.858	11.988	
		BDAC4	0.643	0.738	9.967	
Strategic flexibility		SF1	1.00	1.00	–	0.79
		SF2	0.466	0.872	3.767	
		SF3	0.454	0.777	3.987	
		SF4	0.473	0.795	6.878	
		SF5	0.481	0.814	6.899	
		SF6	0.440	0.628	4.541	
Resilience capabilities	Anticipation capabilities	AC1	1.00	1.00	–	0.71
		AC2	0.336	0.801	6.989	
		AC3	0.388	0.798	7.056	
	Copying capabilities	COP1	1.00	1.00	–	0.69
		COP2	0.232	0.743	15.765	
		COP3	0.269	0.703	15.877	
	Adaptation capabilities	ANT1	1.00	1.00	–	0.80
		ANT2	0.331	0.805	4.891	
		ANT3	0.353	0.823	4.766	

validity signifies that the items are highly loaded onto the construct. The corresponding research model was constructed, and scales and items were adopted. Loading's value and correlations issued from this analysis were used to verify convergent validity, discriminant validity, and internal consistency of scales and items. Table 2 summarizes the main results related to scale validation. To be accepted, the minimum required for item loading must be higher or equal to 0.50. As shown, most items were accepted, and the rest with a low loading were deleted to obtain a purified scale. Moreover, t values are revised to verify the significant of loadings. It is admitted that lodgings are accepted at $p < 0.001$; on this level, a high convergent validity is confirmed. Values on the diagonal indicate the average variance extracted (AVE) level between scale item and its relative construct.

Correlations between constructs are indicated. The variance shared and the correlations are used to appreciate the validity of the discriminants. In this case, the square root of the AVE must be larger than the correlations

Table 4 Correlation, AVE (Average variance extracted) and internal consistency ratio

Constructs	ICR	1	2	3	4	5	6
1 IT capabilities	–	**1.00**					
2 BDA management capabilities	0.899	0.429	**0.885**				
3 BDA infrastructure capabilities	0.961	0.344	0.644	**1.00**			
4 BDA personal capabilities	–	0.289	0.289	0.865	**0.848**		
5 Strategic flexibility	0.862	0.331	0.531	0.664	0.234	**1.00**	
6 Resilience capabilities	–	0.120	0.553	0.432	0.443	0.653	**0.766**

Fig. 2 Structural model results

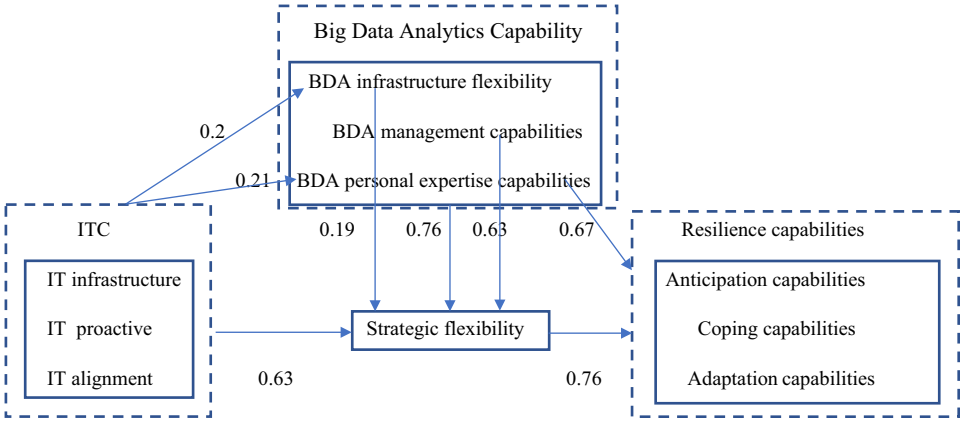

Table 5 Fit index of structural model (mediating hypothesis)

Fit index	RMSEA	NFI	NNFI	CFI	IFI	RFI	GFI	AGFI
Value requires	≤ 0.08	≥ 0.9	≥ 0.9	≥ 0.9	≥ 0.9	≥ 0.9	≥ 0.9	≥ 0.9
Value	0.071	0.971	0.911	0.921	0.933	0.917	0.974	0.937

Table 6 Significance for structural model and path coefficients

Hypothesized paths	Path coefficient and significatively		Hypothesis
	Base model	Mediated model	
ITC → BDAM	1.00 (7.965)	0.932 (6.544)	H4 supported
ITC → BDAI	–	–	H5 rejected—Non-significative
ITC → BDAC	0.36 (3.342)	0.22 (2.458)	H6 supported
BDAM → BDAI	0.90 (5.132)	BDAI cannot be supported directedly by ITC	
ITC → SF	0.63 (3.878)	0.54 (3.773)	H1 supported
ITC → RC	0.21 (2.982)	0.19 (2.913)	H3 supported
BDAM → SF	0.11 (2.061)	0.09 (1.877)	H7 supported
BDAI → SF	0.68 (7.043)	0.87 (5.772)	H8 rejected
BDAM → RC	0.20 (2.879)	This value will be reported to the moderating hypothesis	
SF → RC	0.76 (8.113)	0.63 (5.564)	H2 supported
BDAI → RC	0.19 (2.011)	0.11 (2.322)	H7 supported

Fig. 3 Moderating effect

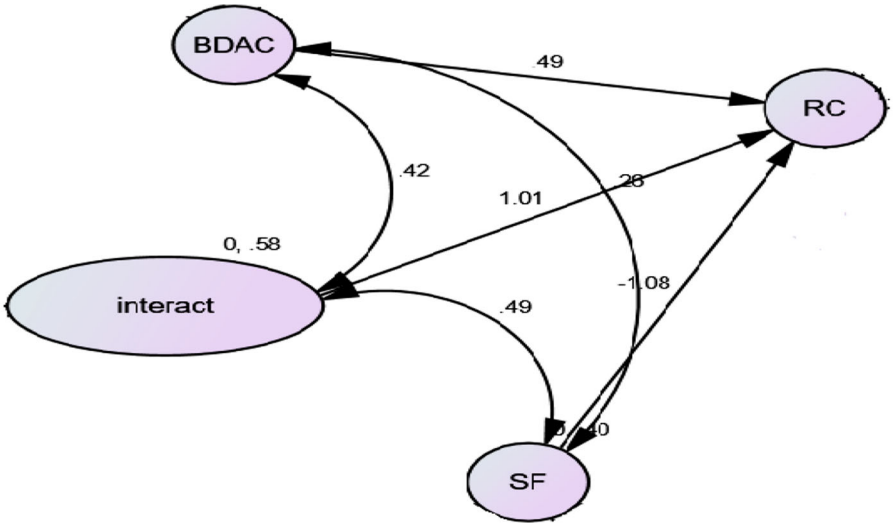

Table 7 Fit index of the structural model

Fit index	RMSEA	NFI	NNFI	CFI	IFI	RFI	GFI	AGFI
Value requires	≤ 0.08	≥ 0.9	≥ 0.9	≥ 0.9	≥ 0.9	≥ 0.9	≥ 0.9	≥ 0.9
Value	0.078	0.901	0.925	0.930	0.908	0.941	0.921	0.910

between the constructs. As can be seen, all diagonal values are greater than all values on the offline diagonal, and this confirms the acceptance of discriminant validity for all constructs. As mentioned at the beginning of this part, reliability related to scale validation was also appreciated, and the internal consistency ratio (ICR) was calculated. To accept the reliability of constructs, ICR has to be greater than 0.70. In this case, all values satisfy this level, which means that all constructs are accepted. At the end of this step, the scales are tested and purified to be used in structural model analysis.

Structural Model Analysis

The structural model was tested using AMOS 24. In the proposed model, resilience three constructs were appreciated by dimensions due to their complexity and multidimensionality as defined in the literature. Resilience capabilities are modeled as a dependent variable and appreciated by three dimensions based on Duchek (2020): anticipation, coping, and adaptation capabilities. BDAC is modeled as a mediating-moderating construct with three main sub-constructs. ITC as the independent variable with two main dimensions and finally SF as a unidimensional construct issued from ITC affect directedly resilience capabilities.

Table 3 details loadings and weights for the constructs; as can be seen, all values are significant. Table 4 presents the square root of average variance between indicators and constructs, as well as correlations. It is clear that all indicators are accepted: ICR, convergent validity, and discriminant validity. It is argued that BDAC mediates the relationship between ITC and SF to develop resilience capabilities, and in this case, only two dimensions are used. The third dimension of this construct, BDA related to infrastructure, moderates the link between SF and RC. According to the recommendation of Baron and Kenny (1986), the authors calculated an interaction value to test the moderating effect and integrated it into the proposed model as a latent variable.

In the collected sample, one of the most important results is the multidimensionality of strategic flexibility. Two dimensions emerge from the analysis with a respective variance of 36.15% and 27.22%, contrary to the definition adopted here. It is supposed that those two dimensions can be represented by the strategic level and flexibility. This concept requires more attention and must be appreciated differently as a composite latent variable.

Figure 2 represents results related to the mediating effect. All fit index of the structural model is detailed in Table 5. The model tested explains 34.4% of the variance in IT capabilities, 43.4% of the variance in big data analytics, 38% of strategic flexibility and only 28% of resilience capabilities. Besides, this supposes the existence of other factors that can support resilience or mechanisms to maximize joint effects reached in this research.

The path coefficients indicate that the majority of hypotheses are supported. As hypothesized, ITC has a strong and positive impact on strategic flexibility (0.63, t = 3.878), which supports the majority of researchers cited below. Examining the impact of ITC on resilience capabilities, it is evident that there is a positive effect, but it seems to be less important than the impact of ITC on strategic flexibility. This result also confirms the interest in the mediating and moderating effects. Proportionally, the effect of SF on RC is positive and strong enough (0.76). This supposes that to be resilient, organizations must develop strategic flexibility that depends on ITC. There is a joined effect of SF and ITC on resilience capabilities.

According to the sample, it is confirmed that

- The direct effect of ITC on resilience was positive and significant but reduced with the integration of SF
- The same direct effect ITC-RC is ameliorated by the integration of BDAM and reduced by BDAI with a negative effect
- BDAI stimulate the link between ITC and RC but not the link ITC-SF
- BDAM support the effect of ITC on SF
- BDAC reduce the effect of ITC on SF
- Independently, the positive effect of ITC on BDAC is positive and significant. The biggest data analytic capabilities developed by information technology are related to the management capabilities, which demonstrate the friability of such technology to treat, analyze and collect data for real-time decision-making.

Moderating Effect

To test hypotheses, the authors ran a new model in which a new variable named interaction is added after standardizing all variables. Using SPSS 16, the researchers computed values of SF, RC and BDACI and extracted the new database on AMOS 24. The findings confirm the moderation hypotheses. BDACI moderates the effect of SF on CR. The relationship between the three variables was significant and positive. A partial moderating effect was detected here. This supposes the existence of other possible variables which can contribute or stimulate this effect, such as organizational cultural.

Figure 3 represents results related to the moderating effect. The model after the integration of the new variable appreciated by the interaction between SF and BDACI seems to be representative, and all fit indexes are acceptable.

Table 7 summarizes the different fit indices of the new structural model, and as can be seen, all values are significant. The structural model is well represented with the interaction value introduction. So, it confirms the moderating effect of BDAC on the link between strategic flexibility and resilience capabilities.

Discussion

Synthesis of Findings

With reference to the first question of this study, it is found that BDA capability is a catalyst which can enhance resilient organizational activities and awareness of possible changes in the business and strategic management by anticipating, adapting and coping. Findings indicated that the effect of ITC on strategic flexibility in the actual circumstance of post-COVID-19 was less than the effect of BDAC. Dynamic capabilities approach adopted for IT and BDA was positively associated with resilience, but their corresponding impact seems indirect. Based on the second research question, the findings demonstrate that BDAC was a fundamental variable in recreating the effect of strategic flexibility on organizational resilience with a total moderating effect. Finally, in the third question pertaining to the direct effect of ITC on strategic flexibility, the findings indicated that IT capabilities can stimulate strategic flexibility under specific conditions (Oberoi et al.,et al. 2007; Tallon, 2008). Therefore, organizations adopting and defining BDAC on management, personal and infrastructure levels should stimulate strategic flexibility, which generates and guarantees the development of organizational resilience automatically as well as enterprise performance management (Akhtar & Mittal, 2010; Dey et al.,et al. 2019).

The empirical implications section details the managerial and practical implications of interventions stemming from the findings. In an attempt to answer research questions regarding the mediating and moderating effect of BDAC, this research has presented both practical and theoretical implications. First, it confirmed viewpoints on how BDAC, ITC and strategic flexibility improve and influence organizational resilience if developed under a dynamic capability perspective. This converges with Singh et al. (2021) who detailed this approach using a bibliometric analysis. BDAC amplify the impact of ITC on strategic flexibility. Thus, strategic flexibility enables organizational resilience, and as stronger the use of BDAC is high and adequate, the level of organizational resilience generated is higher.

Theoretical Implications

As mentioned earlier, the dynamic capability view (DCV) has gained great importance in the IS field as a conceptual perspective to explain competitive advantage development

in complex and turbulent environments (Steininger et al.,et al. 2021). In alignment with that, and based on such a theoretical approach, the findings of this research explain how and when organizational capabilities can be considered an organizational competence to manage, understand and prevent turbulence (Li and Chan, 2019). Further, this research expands the main scope of DCV by including implicit and new underlying forces (the mediation – moderation of BDA capability) to the resilience path of SMEs. This amalgamation of BDA capabilities with dynamic capabilities will guide and assist SMEs in harmonizing and aligning their external environment with threats and opportunities. The main challenge of contemporary SMEs lies in the perfect and speed alignment of dynamic and operational capabilities (Zighan et al.,et al. 2021).

The core role of DCV is to study organizational competitive advantage development in increasingly turbulent environments (Teece & Pisano, 1997). Transposed to IT, DCV introduces some new concepts that are considered fruitful for IT business value because it can help to explain how organizations can renew and develop some value-generating mechanisms within the means of information's technology (Schryen, 2013). This can complement and enrich existing knowledge in the field of IT business by identifying specific abilities or processes enabled by the use, mobilization and deployment of IT, adding to the generation of many performance outcomes (Melville et al. 2004; Schryen, 2013). Based on this, DCV seems helpful in explaining how IT can be considered a privileged strategic driver for organizational change in high-velocity environments (Galliers et al. 2012).

Therefore, this research belongs to the few empirical studies which devoted attention to the significance of IT dynamic capabilities to sustain and confirm that IT can assist an organization in increasing its strategic values and improving organizational resilience (Arunima et al. 2016; Sumant, 2005). This is still also available for BDA (Grover & Kar, 2017; Kushwaha et al. 2021). This research provides additional opportunities to adopt further empirical research about IT dynamic capabilities, big data analytic capabilities and organizational resilience such as Singh et al. (2019). It is still one of the pioneering types of research that details and investigates the impact of DCV from an organizational resilience perspective on SMEs and points out its importance as well as the urgent need for further research in this field to understand, apply, use and handle IT dynamic capabilities on organizational resilience if supported by a DCV of BDA. Further, this research recommends that BDAC should be viewed and considered a primordial strategic element due to its positive impact on strategic flexibility, the main source of organizational resilience. It is claimed that a BDA management capability is an important aspect of reinforcing the effect of ITC and strategic flexibility. Based on findings, it is obvious that BDA management capability is the major factor in developing organizational resilience in direct and indirect aspects.

Practical Implications

This research makes several practical and pragmatic contributions. Empirical evidence argues that IT capabilities coupled with BDA capabilities could enable resilience and witness the importance of investing in the development of ITC as well as the introduction of BDA. The findings support the viewpoint related to the positive effect of BDA on resilience (Rialti et al.,et al. 2020) and the fact that BDA can constitute a competitive advantage for achieving organizational resilience (Vossen, 1998). Many senior executives admit the strategic value of IT tends to consider IS activities as basic and suppose that it can reduce costs (Ravichandran, 2018), and it must be revisited or planned to achieve cost-cutting. The result supposes that IT capabilities and BDA are valuable for strategic flexibility and resilience, but developing such capabilities must be revisited. Organizations must consider investing in training programs to acquire and improve IT capabilities. Such capabilities must be maintained, and it is a cumulative learned process that can take time and must be managed. This point addresses another critical aspect compared to the findings: the internal process of resilience. Coordination, complementarity and sustainability of the development of IT capabilities are not independent or separated processes. It is a collective learning process which means that a systemic approach must be considered to maintain resilience. Knowledge, information, time, and IT develop and sustain resilience. There is a synergetic effect that must be maintained as long as possible to achieve organizational resilience. It is admitted that there is not a one-way process but an interactive one. IT capabilities by integration and alignment, alimented by BDA on the term of data and information in the right time by the right way, facilitate the strategic decision-making through an equilibrium intern/extern to establish strategic flexibility and consequently resilience because in such case, the organization will be able to adapt and continue according to the external need but, also, create an ideal internal solution. In addition, this process can be repeated as much as needed to provide organization expertise, and every time, its IT capabilities

are reinforced and can be automized by BDA to develop an immune system at the end. An adequate managerial agenda can make this dream reality through an appropriate strategic plan defined in parallel with the organizational strategic plan.

Limitations and Future Research

Independently, several limitations can be identified in this research. Initially, SMEs used in this study belong to different sectors, which might define some limitations in terms of time effect or contextual factors affecting causality associations between research variables. Further, data collected and used were gathered throughout only one country, this can limit the significance of results, and a multicultural approach can be more benefic in generalizing findings. The findings revealed that an IT dynamic capability added to BDAC could develop strategic and resilience capabilities. Hence, they call for much more empirical and theoretical investigation in this research domain. Further, the combination of IT capabilities, BDA capabilities, strategic flexibility and organizational resilience is complex. It connotes linear and nonlinear mechanisms that have to be identified, defined and measured to reinforce the critical pathway for organizational resilience in SMEs. That is said, the current model identified and tested can be expanded and enriched to include additional moderating factors such as organizational culture or size that can enrich our understanding of mechanisms that foster organizational resilience.

Conclusion

This research details a new progression to the existing research effort exploring the impact of ITC on organizational resilience through strategic resilience and BDAC in SMEs in Saudi Arabia. More specifically, this study has adopted the perspective of DC to explain the significance of OR on SMEs. In fact, the study supposes that the dynamic capabilities of ITC play a capital role in identifying and amplifying the value of strategic flexibility, which needs to be assisted by BDAC. In the contemporary environment, SMEs have to be equipped with ITC and BDAC required to develop strategic flexibility (Rialti et al.,et al. 2020). Toward that end, a sample of SMEs in Saudi Arabia was obtained using a questionnaire to collect data. The research findings indicated significant and positive associations among information technology capabilities, big data analytic capabilities, strategic flexibility and organizational resilience. More precisely, strategic flexibility positively and significantly mediated the relationship between IT capabilities and organizational resilience. This implies an additional need for managers to define and understand the concept of strategic flexibility in order to design appropriate plans to boost organizational resilience (Onyokoko & Needorn, 2021; Uzoma Ebubechukwu and Edwinah, 2022). This also involves adaptation, copying and anticipation capabilities (Duchek, 2020). With big data analytics capabilities, organizations can share internal and external knowledge, especially through integration and analysis processes (Merhi & Bregu, 2020), to improve environmental response and optimize adaptation processes to achieve dynamism (Božic and Dimovski, 2019).

Appendix A

Constructs	Dimensions	Items	Supporting literature
Information technology capabilities (ITC)	IT Integration	Our firm transfers data with our partners	Rai and Tang (2010)
		Our firm provides a seamless connection between our partner systems and our systems	
		Our firm easily aggregates relevant information from our partner databases	
		Our firm easily accesses data from our partners	
	IT Alignment	Our firm's IT plans to reflect the business plan goals	Kearns and Lederer (2003)
		Our firm's IT plans to support business strategies	
		Our firm's IT plans recognize external business environment forces	
		Our firm's plans refer to IT Plans	
		Our firm's plans refer to specific information technologies	
Strategic flexibility		Respond to changes in aggregate consumer demand	Thomas (2014)
		React to new product launches by competitors	
		Introduce a new pricing schedule in response to changes in competitor's prices	
		Expand into new regional or international markets	
		Change (i.e., expand or reduce) the variety of products available for sale. Adopt new technologies to produce better, faster and cheaper products	Wamba et al. (2017)
Big Data Analytics Capabilities	BDA management capabilities	BDA planning	
		BDA decision-making	
		BDA coordination	
		BDA control	
	BDA Infrastructure flexibility	BDA connectivity	Wamba et al. (2017)
		BDA compatibility	
		BDA modularity	
	BDA personal capabilities expertise	BDA technical knowledge	Wamba et al. (2017)
		BDA Technology management	
		BDA business knowledge	
		BDA relational knowledge	
Resilience capabilities (RC)	Adaptation capabilities	Observation	Duchek (2020)
		Identification	
		Preparation	
	Copying capabilities	Accepting	Duchek (2020)
		Developing	
		Implementation solutions	
	Anticipation capabilities	Reflection	Duchek (2020)
		Learning	
		Organizational change	

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Declarations

Conflict of interest The authors declare no competing interest.

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