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Article

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Journal of Innovation & Knowledge (JIK)

Provided in Cooperation with:

Elsevier

Suggested Citation: Al Omoush, Khaled Saleh; Ribeiro-Navarrete, Samuel; Lassala, Carlos; éSkare, Marinko (2022) : Networking and knowledge creation: Social capital and collaborative innovation in responding to the COVID-19 crisis, Journal of Innovation & Knowledge (JIK), ISSN 2444-569X, Elsevier, Amsterdam, Vol. 7, Iss. 2, pp. 1-11, <https://doi.org/10.1016/j.jik.2022.100181>

This Version is available at:

<https://hdl.handle.net/10419/260995>

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Networking and knowledge creation: Social capital and collaborative innovation in responding to the COVID-19 crisis



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ARTICLE INFO

Article History:

Received 29 January 2022

Accepted 14 March 2022

Available online 18 March 2022

Keywords:

Social capital

Collaborative innovation

Collective intelligence

Organizational sustainability

COVID-19

ABSTRACT

This study empirically explores the role of social capital in creating collaborative innovation and collective intelligence and maintaining organizational sustainability in the unprecedented COVID-19 crisis. Data were collected from a sample of 289 managers, directors and heads of departments of top 50 manufacturing firms in Jordan and analyzed using Smart-PLS-SEM. The results indicate that social capital significantly impacts collaborative innovation, collective intelligence and organization sustainability during the COVID-19 crisis. They also reveal that collective intelligence significantly impacts collaborative innovation and organization sustainability. This study enriches the literature on social capital, collaborative innovation and collective intelligence. It elucidates the role of such dynamic capabilities in maintaining both organizational sustainability and the chance of recovery from unprecedented crises.

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Introduction

The worldwide effects of COVID-19 have created unprecedented challenges for business organizations across all sectors and industries, forcing them to sense and respond innovatively. The term sustainability is used here to indicate an organization's ability to exist in a highly competitive environment with strong competitors and to resist extreme crises that threaten its survival and growth (Meflinda et al., 2018). The pandemic has caused one of the biggest environmental changes since the 1930s Great Depression (Heisbourg, 2020). Collaboration and the coordination of physical and intellectual resources and capabilities have always been lifelines for organizations and partners in such turbulent environments. These collaborations and structures of coordination need stable and flexible social networks between all the actors in the environment, including competitors. Effective collaboration and coordination efforts rely mainly on high levels of relational assets that support common interests and value co-creation.

Social capital has received more attention in recent decades, particularly within collaboration and innovation research. Research has also recently begun to view social capital as a potential protector against the problems caused by COVID-19 (Gölgeci &

Kuivalainen, 2020; Putra et al., 2020; Corrêa et al., 2021). This intangible asset is one of the three principal constructs of intellectual capital. Social capital is widely acknowledged as an indispensable component of inter-organizational relationships (Gölgeci & Kuivalainen, 2020). It consists of the social networks of relationships, patterns, expectations and beliefs that promote interactive collaboration and coordination for mutual benefits (Putnam et al., 1994). Therefore, it is understood to be a fundamental driver of collaborative and collective activities that contribute to the continuous development of the dynamic capabilities of organizations, such as collaborative innovation and collective intelligence.

Innovation is a crucial dynamic capability for survival in reacting to unanticipated environmental developments and handling short and long-term risks and challenges (Gil-Alana et al., 2020; Hilmersson & Hilmersson, 2021), and collaboration is recognized as an attribute of innovation. The social network approach considers innovation a result of collaborative knowledge exchanges and includes a wide diversity of participants in conditions of interdependence. Pinto (2020) concluded that, in more complex situations, such as the COVID-19 crisis, organizations strive for collaboration and coordinate their collective capabilities to explore innovative solutions in countering unpredictable changes. Recent literature confirms that the fluctuations of consumers' priorities and decisions, volatile under unpredictable uncertainties, force firms to improve their knowledge in collaboratively creating

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novel innovations based on their relational networks with business partners and other actors (Shen et al., 2021).

COVID-19 has produced a risky and disruptive environment, threatening the long-term survival and sustainability of organizations. The highly complex, multi-faceted challenges introduced by the pandemic force organizations to behave as adaptive human systems with diverse capabilities and expertise in order to preserve their sustainability and superiority. According to Nga and Liang (2010), this adaptive behavior view adopts an innovative path to examine an organization as an intelligent entity that strives for survival and growth through exploiting its intelligence. Garrido (2009) took intelligence to be the property of a collective. Based on the collaborative viewpoint, scholars (e.g., Staskeviciūtė et al., 2006; Elia et al., 2020) argue that organizations become intelligent only when they can create an outstanding level of collective intelligence. This adaptive dynamic capability is the collective ability of groups or organizations to use information and knowledge: that is, to think, solve problems, learn, generate and understand valuable complex ideas and plan for the future (Gan & Zhu, 2007; Yaseen et al., 2018).

There is still a need to explore the extent of the association between social capital and innovation, especially in unprecedented crises. More particularly, there is a gap in our knowledge around the role of social capital in creating collaborative innovation during turbulence and high instability in market demand (Ghahtarani et al., 2020). Although extensive research has been done on social capital as a collaborative mechanism for improving dynamic capabilities in normal conditions, the literature lacks empirical evidence of whether social capital generates collective intelligence under the pressure of such crises as the COVID-19 epidemic. A previous research review also implies a lack of empirical studies linking social capital with the survival and sustainability of organizations. Neither have there been investigations empirically analyzing the role of collaborative innovation and collective intelligence in preserving sustainability during crises threatening organizational survival.

Aiming to fill this gap in the literature, this study aims to examine the role of social capital in creating the collaborative innovation and collective intelligence needed to preserve organizational sustainability during unique global crises, using the example of COVID-19. It also examines the role of collaborative innovation and collective intelligence in maintaining organizations' survival and sustainability. This study adds to the currently scarce literature on the role of social capital in developing dynamic capabilities, including collaborative innovation and collective intelligence, in responding to unprecedented crises. It also contributes to the literature on the forces driving organizational sustainability during crises threatening their survival.

Literature review

The COVID-19 shock has opened new horizons to re-examine, in light of the unprecedented worldwide crises, many of the theories, concepts and relationships addressed in the literature of management, organization and collaborative relations. This crisis has invited us to address new areas of collaborative relations and their impact on developing the dynamic capabilities that enable firms to respond to the accelerating, erratic changes in the business environment. The COVID-19 crisis has prompted new ways of examining the determinants of organizational survival and sustainability, seeking more of the knowledge needed to control more of the factors influencing such crises.

The literature has long considered social capital the foundation of collaboration between business environment actors, especially in crises and market turbulence (Akçomak & Ter Weel, 2009; Aldrich & Meyer, 2015; Lins et al., 2019). Most social capital definitions revolve around the capabilities and resources obtained through social relations, collective working and external ties rooted in organizations' social networks and used to achieve shared objectives (Adler &

Kwon, 2002; Yeşil & Doğan, 2019). Recently, scholars (e.g., Putra et al., 2020; Corrêa et al., 2021) have argued that social capital has played a significant role in responses to the COVID-19 crisis. Akçomak and Ter Weel (2009) claimed that social capital makes it possible to implement complex collaboration amongst organizations who share collective interests. Prior research (e.g., Adler & Kwon, 2002; Akçomak & Ter Weel, 2009; Aldrich & Meyer, 2015) has emphasized that every company has some degree of social capital. Yeşil and Doğan (2019) recently confirmed that further research is needed on the dynamics, implications and needs of social capital across different organizational contexts and environments.

In highly competitive and uncertain environments, innovation has always been a recipe for survival and sustainability. The decisive role of innovation in the life and fate of organizations has prompted researchers and practitioners to take an interest in its determinants. Social capital has been a vital addition to innovation-creating factors. The literature contains many investigations of how social capital determines innovation (Pérez-Luño et al., 2011; Yeşil & Doğan, 2019; Corrêa et al., 2021). Nowadays, innovation is considered the result of collaborative efforts rather than a novel work of a single entity (Krishnan et al., 2021). Much of the literature confirms that most of the resources making for innovation spread beyond a single organization's boundary. That is, external collaboration is a fundamental source of novel ideas, including new products, services, creative processes, new technologies and innovative solutions to unusual problems and challenges (Putnam et al., 1994; Pérez-Luño et al., 2011; Gölgeci & Kuivalainen, 2020). According to Osborn and Hagedoorn (1997), the resource-based theory implies that collaboration between business partners is needed for the development of various complementary capabilities, including innovation. Collaborative innovation describes an organization's capability to create, integrate, and transform diverse knowledge, brainstorm, perspectives, and ideas into innovations in the context of value co-creation, which brings benefits for all participants (Skippari et al., 2017; Heil & Bornemann, 2018; Shen et al., 2021). However, although the need for collaboration can prompt very close relationships between collaborative innovation and social capital, this potential relationship has received very little attention from previous studies, particularly during the COVID-19 crisis, leaving a significant research gap.

Collective intelligence has been of interest in several scientific disciplines for many years. Scholars have found that groups of individuals and organizations can bring more intelligence than independent actors to the search for speedy, efficient solutions to complex problems and to improvements in decision-making (Heylighen, 1999; Pór, 2014). Lykourantzou et al. (2011) argue that collective intelligence is primarily the application of the wisdom of crowds, the outcome of crowdsourcing. Heylighen (1999) confirmed that cognitive shortcomings and biases at the individual and organizational levels have significantly contributed to the search for emerging intelligent behaviors at collective levels. According to Pór (2014), collective intelligence is perceived as the dissolution of the obstacles and boundaries engendered by individualism and the opportunity to exploit collective cognitive capabilities.

The literature confirms that the developments in collaboration environments enabled by the advance of digital technologies have created the foundations for the emergence of the field of collective intelligence (Pór, 2014; Elia et al., 2020). However, collaborative innovation, social capital, and collective intelligence share two features: that collaboration and the availability of mutual benefits for all participants enhance dynamic capabilities through value co-creation. Despite this, few empirical studies have explored the relationship between social capital, collective intelligence, and collaborative innovation.

The literature confirms that organizations are increasingly exposed to crises and challenges that threaten their existence and sustainability (Tu, 2020; Krishnan et al., 2021). COVID-19 has ended

the lives of many companies, and many are still threatened. Sustainability in firms means their maintaining their survival and long-term continuity through their ability to adapt (Starik & Rands, 1995). The literature on COVID-19 contains many recent studies examining the driving forces of business and supply chain sustainability under the pressures created by the epidemic (Ivanov, 2020; Sarkis, 2020; Srikalimah et al., 2020). But no previous research has studied the relationship between social capital and sustainability, nor, in an integrated research model, the relationship between collaborative innovation and collective intelligence and sustainability COVID-19.

Research model and hypotheses

Fig. 1 represents research constructs and their casual relationships. It proposes that social capital significantly impacts collaborative innovation, collective intelligence, and organizational sustainability. It also posits that collaborative intelligence and collective intelligence significantly impact organizational sustainability. This study also proposes that collaborative intelligence significantly impacts collaborative innovation.

Social capital and collaborative innovation

The literature recognizes that enhancing levels of collaboration, where some form of social exchange is needed, contributes to better innovation outcomes (Landry et al., 2002; Yeşil & Doğan, 2019; Pinto, 2020). There is a common belief that the level of social relations explains why collaborations succeed or fail to reach their expected outcomes (Malmström & Johansson, 2015; Steinmo & Rasmussen, 2018; Mignenan, 2021). Social networking theory has provided a significant contribution on the role of collaborative relationships in innovative co-creation (Hardwick & Anderson, 2019). The research suggests that establishing strong ties with business partners through social interactions critically affects firms' success in obtaining resources and capabilities for collaborative innovation (Steinmo & Rasmussen, 2018; Jiao et al., 2019; Méndez-Picazo et al., 2021).

Innovation co-creation is essentially a social process (Skippari et al., 2017). According to Hardwick and Anderson (2019), collaboration for co-creating innovation is a prime exemplar of engagement as a deep relational connection in business relationships. Scholars have emphasized that the social capital approach has provided a solid basis for explaining the impacts of external and internal relationships on innovation (Blomqvist & Levy, 2006; Pérez-Luño et al., 2011; Steinmo & Rasmussen, 2018). Social capital has been considered a major contributor to the success of open, collaborative innovation (Mu et al., 2019). According to Daniel et al. (2018), the relation-orientated leadership behavior inherent in many features of social capital is a significant factor in the achievement of open, collaborative innovation.

Knowledge is a core source of innovation. The intensive reliance of collaborative innovation on knowledge necessitates expertise and intellectual capabilities beyond a single organization's boundaries. Organizational leaders with external social capital capabilities can bring new, complementary knowledge from external sources (Daniel et al., 2018). Steinmo and Rasmussen (2018) argue that social capital conceptualizes the knowledge embedded in organizations' networks and relationships. Social exchange is a vital element in knowledge creation. Knowledge transfer among business partners provides a platform for inter-organizational collaborating and learning, which creates new knowledge, thus enhancing innovation capability. Collaborative innovation creation needs an intensive transformation of tacit knowledge from participants, which requires strong social ties (Wang et al., 2017). Many studies also agree that in collaborative innovation, transferring tacit knowledge often requires a range of methods of communication and contact that can be difficult without social networks and deep relationships (Blomqvist & Levy, 2006; Hardwick & Anderson, 2019). According to Pérez-Luño et al. (2011), the characteristics of social capital mean that it plays a central role in any management of tacit knowledge intended to develop collaborative innovation.

According to Pérez-Luño et al. (2011), the social capital framework implies that generating innovation does not only require several participants and the appropriate network relationship structure.

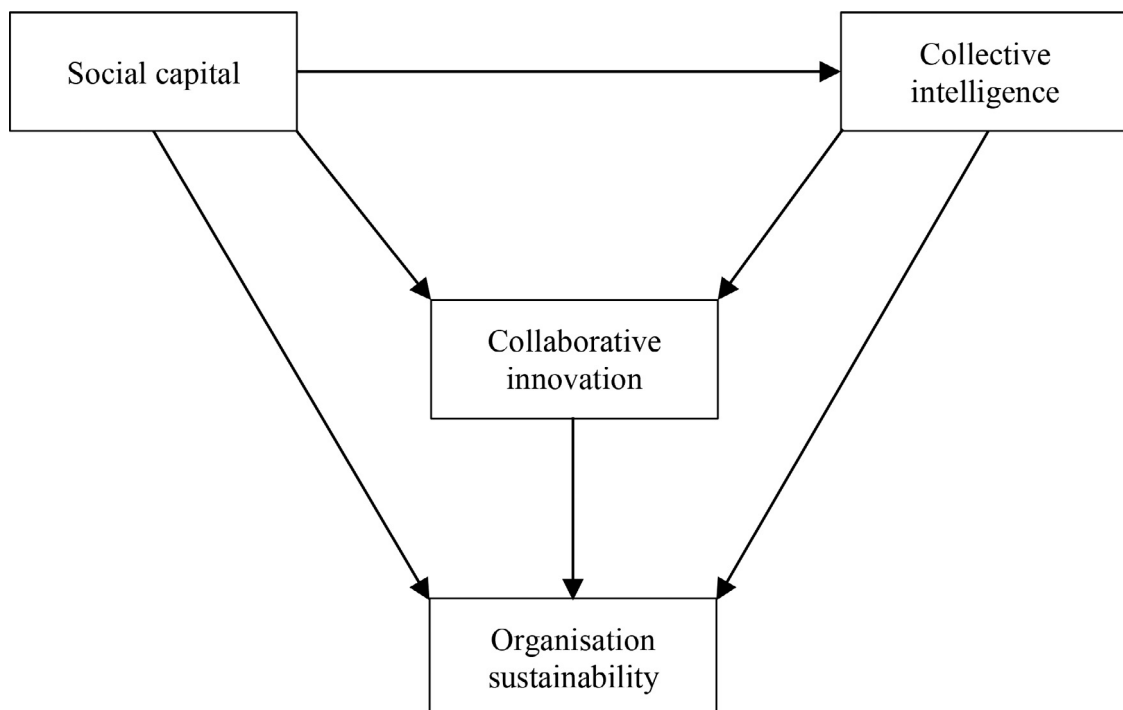


Fig. 1. Research model. The proposed relationships and their associated hypotheses are discussed below.

It also involves trust, commitment, and the cohesiveness inherent in the inter-organizational relationships: that is, not only the traditional factors such as coordination, technology, and transaction costs, which are not enough for collaborative innovation, particularly in dynamic and unpredictable environments (Blomqvist & Levy, 2006; Hardwick & Anderson, 2019). Based on the discussion above, this study proposes:

H1. Social capital significantly impacts collaborative innovation.

Social capital and collective intelligence

According to Heylighen (1999), the limitations and biases of an individual's cognitive and epistemic capacities have been major reasons for the emergence of collective intelligence behavior. Collective intelligence is a kind of socially constructed co-creation (Dellermann et al., 2020; Mignenan, 2021). It consists of the relationships intelligence that fosters the sharing of individual intelligence in collaborative environments (Scarlat & Maries, 2009). This implies that organizations' social networks have an obvious role in generating collective intelligence. An interesting conceptualization of collective intelligence sees it as having three dimensions: human, organizational and relational (Secundo et al., 2016; Mignenan, 2021). Social capital encapsulates capabilities and resources deep-rooted in social relations and networks that facilitate collective actions. Ng and Liang (2010) show that network connectivity is necessary for sustaining robust collective intelligence. Several studies have shown that previous collaborative experience, existing networks, and many elements of social interaction are crucial determinants of collective intelligence success (Gan & Zhu, 2007; Pór, 2014; Mignenan, 2021).

Collective memory, the repository for stored information, generated intelligence, and accumulated knowledge that results from internal and external collaboration, is fundamental to the concept of collective intelligence (Gan & Zhu, 2007). Li et al. (2019) asserted that strong network cohesion and social connections support the knowledge creation that forms collective intelligence.

Based on collaboration and knowledge sharing, the dynamic community capability provided by collective intelligence can implement tasks or solve problems more effectively than individual firms (Mignenan, 2021). Several scholars have indicated that knowledge sharing promotes collective intelligence (Lykourantzou et al., 2011; Pór, 2014). Heylighen (1999) argued that the primary role of collective intelligence management is to facilitate the creation, transfer, and sharing of knowledge. It has also been claimed that collective intelligence is the knowledge shared through social networks, where organizations learn faster through sharing knowledge to improve their adaptive capacities (Li et al., 2019). Given the effects of strong bonds and trust, many studies (e.g., Adler & Kwon, 2002; Steinmo & Rasmussen, 2018) have argued that relational social capital is the most vital element in facilitating collaborative knowledge transfer.

The literature has acknowledged collective cognition—including adjusting participants' mutual understanding, sharing meaning, and constructing collective conceptual thinking—as a principal dimension of collective intelligence (Scarlat & Maries, 2009; Lykourantzou et al., 2011). Several studies have recognized the capabilities of cognitive social capital and its role in sharing interpretations, narratives, meanings, common languages, and mutual understanding in order to develop and exchange knowledge (Steinmo & Rasmussen, 2018; Mignenan, 2021). Collective intelligence is also principally responsible for the process of continuous collective learning as a way for adapting to unexpected situations and environmental changes (Ng & Liang, 2010). Studies have also revealed that iterative social interactions are the primary enabling mechanisms of collaborative learning (Dellermann et al., 2020; Mignenan, 2021). Therefore this study hypothesizes:

H2. Social capital significantly impacts collective intelligence.

Social capital and organizational sustainability

Many previous studies agree that a firm's failure or continued survival is mainly contingent on its intellectual capital capabilities (Hormiga et al., 2011; Conroy & Deller, 2020; Tu, 2020). Social capital has been widely considered a strategic organizational asset in attaining superior sustainable performance and sustained value creation (Gligor et al., 2013; Gölgeci & Kuivalainen, 2020). Lo et al. (2021) also investigated how social capital assists firms to achieve and maintain sustainable competitive advantage. According to Conroy and Deller (2020), social capital with strong networks and high levels of trust plays a pivotal role in reducing transaction costs and increasing information flow, thus enhancing business survival rates. Conroy and Deller (2020) confirmed that information flow in such networks strengthens conditions in start-up projects, thus increasing survival rates.

Social capital is a significant determinant of continuity strategies in SMEs (Meflinda et al., 2018). Corrêa et al. (2021) claimed that social capital helps to ensure the business's survival in crises and market volatilities. In today's evolving knowledge economy, corporate sustainability is contingent more on knowledge resources. Social capital exerts a critical impact in highly turbulent environments by empowering companies to employ accumulated knowledge swiftly and to acquire and integrate new knowledge, allowing them to respond rapidly to emerging threats or opportunities (Pinto, 2020). However, Aldrich and Meyer (2015) have highlighted how social capital help organizations to survive and recover during and after disasters. During the covid-19 crisis, Mignenan (2021) argued, sharing social capital has significantly contributed to business survival. Likewise, Mubarik et al. (2021) also found that organizations with well-integrated social capital are more successful in mitigating the COVID-19 effects, improving their opportunities to survive and recover. Other studies have found that higher levels of relational capital and partners' ability to leverage business networks connectivity are related to higher success and sustainability (Hormiga et al., 2011; Zhao & Burt, 2018; Prokop et al., 2019).

Firms do not operate in isolation. Therefore, developing social capital provides a better connection to resources and markets, thus maintaining survival and prosperity (Conroy & Deller, 2020). Hou and Neely (2013) view social capital as a firm's relationships and relational networks with business partners, where one partner possess resources needed by the other to sustain its survival. Resource dependence theory confirms that organizations' survival depends on mobilizing the resources required to fulfil their business objectives (Hessels & Terjesen, 2010). Such resources are not accessible to organizations without effective and efficient networking with partners in the pursuit of mutual benefit. Resources, capabilities, and markets that a firm cannot obtain in isolation could be reached through building stable relationships networks across the industry (Karami & Tang, 2019). Formal and informal networks enable a firm to develop social capital through shaping and strengthening network ties, promoting commitment, and increasing trust among partners, allowing it to acquire the necessary resources (Saha & Banerjee, 2015). Given the above discussion, this study hypothesizes:

H3. Social capital significantly impacts organizational sustainability.

Collective intelligence and collaborative innovation

The ability of an organization to innovate is a function of its organizational intelligence (Staškevičiūtė et al., 2006). Collective intelligence leverages the innovation potential of groups to convert opportunities into innovative solutions and ventures (Elia et al., 2020). It consists in the activities of a large group of collaborating individuals, working as a single entity to produce higher-order intelligence, solutions, and innovations (Lykourantzou et al., 2011).

Mignenan (2021) confirms that collective intelligence leads to wiser decision-making, the co-generation of novel ideas and the co-construction of creative solutions, which are at the core of the collaborative innovation process. It is a community platform of intellectual collaboration for creation, innovation, or invention. It has been argued that crowdsourcing, a mechanism to access collective intelligence, is invaluable in the search for innovative ideas (Lykourantzou et al., 2011; Dellermann et al., 2020).

A collective intelligence framework improves our knowledge about how organizational structure, connectivity, and collaborative technologies support the generation of desired innovation outcomes (Secundo et al., 2016). According to Elia et al. (2020), collective intelligence is based on collaboration, coordination, and connections among participants aimed at generating, refining, and developing innovative ideas that can be transformed into successful ventures. Weng et al. (2018) found that effectively managing online co-intelligence activities enables firms to improve online collaborative innovation. Identifying and motivating participants who can contribute to emerging collective intelligence is a crucial determinant of success in community-based innovations (Mačiulienė & Skaržauskienė, 2016). Weng et al. (2018) emphasized that the participation of business partners in co-intelligence processes, which generate value for all contributors through collaborative innovation, is vital for today's firms.

Successful collective intelligence enables multiple contributions and perspectives, generating open environments for collaboration to develop innovative concepts for future breakthrough innovations (Elia et al., 2020). Cognition—the processes of knowing, reasoning, and judgment—is a primary dimension of intelligence. According to Hardwick and Anderson (2019), it involves the knowledge that partners bring when participating in the co-creation of innovation. Collaborative innovation requires exchanging and sharing knowledge in generating novel innovations that are not achievable by an organization alone (Daniel et al., 2018). Wang et al. (2018) suggest that knowledge-inspired innovation design and capture are functions of collective intelligence. Therefore, this study suggests:

H4. Collective intelligence significantly impacts collaborative innovation.

Collective intelligence and organizational sustainability

The development of dynamic capabilities and collective skills in the context of increasingly intense competition has been associated with both competitive performance and company survival and sustainability (Zhao & Burt, 2018; Conroy & Deller, 2020). Survival defines sustainability, and intelligence enhances the chances of an organization's survival (Garrido, 2009). Many previous studies were dedicated to investigating collective intelligence as a dynamic capability in building collective competence and increasing resilience in complex situations and rapidly changing environments (Ng & Liang, 2010; Elia et al., 2020). According to Lo et al. (2021), the shocking effects of COVID-19 have forced companies, as adaptive systems, to pay more attention to their need for survival and, therefore, to their resources for resilience. Explaining why, under the same COVID-19 measures, many firms experienced a substantial loss of value while others did not, Mignenan (2021) found that collective intelligence was the crucial differentiating factor.

Collective intelligence establishes the ability to discover a roadmap for business sustainability (Conroy & Deller, 2020). Elia et al. (2020) consider collective intelligence a valuable support for developing more effective and sustainable solutions and ventures. It is considered essential to sustainable value co-creation by business partners chains (Secundo et al., 2016). In complex and dynamic environments, intelligent organizations not only guarantee survival and sustainability but also gain competitive superiority (Staškevičiūtė

et al., 2006). An entity's ability to maintain its intelligence in changing environments depends on its ability to orientate its learning to the imperative of sustainability (Gan & Zhu, 2007; Garrido, 2009; Dellermann et al., 2020). The literature emphasizes that organizational intelligence empowers enhanced responsiveness and rapid adaptation to unexpected environmental changes and increasingly optimal use of resources, which strengthens sustainability (Staškevičiūtė et al., 2006; Garrido, 2009; Li et al., 2019).

Sustainability requires a firm to be highly sensitive, to think dynamically, to respond quickly and to recreate itself, both currently and continuously. As a non-human adaptive living being, an organization can be perceived as a series of activities. Its sustainability depends on its ability to reproduce itself constantly in order to remain coherent with its environment (Garrido, 2009). Surviving and thriving in fast-changing, complex operating environments requires high degrees of flexibility, agility, and renewal capabilities. Organizations, as complex adaptive systems, need to be intelligent enough to adapt and sustain themselves in such unpredictable environments (Ng & Liang, 2010). Intelligent behavior reveals an organization's ability to operate in conditions of uncertainty through adaptation capabilities (Gan & Zhu, 2007; Pór, 2014). Staškevičiūtė et al. (2006) argued that the ability to adjust agilely to unpredictable changing situations is a vital characteristic of intelligent organizations. Other authors have argued that collective intelligence is all about the perception of, modification of and adaptation to an environment (Gan & Zhu, 2007; Pór, 2014; Dellermann et al., 2020). Drawing on the above, this study hypothesizes:

H5. Collective intelligence significantly impacts organizational sustainability.

Collaborative innovation and organizational sustainability

Innovation has long been considered a creative dynamic ability to respond to unforeseen situations. Greco et al. (2021) confirm that what differentiates successful from unsuccessful organizations is the ability to innovate. The literature emphasizes the importance of innovation in organizations' ability to remain competitive (Akçomak & Ter Weel, 2009; Steinmo & Rasmussen, 2018; Yeşil & Doğan, 2019). Many studies have investigated the role of sustainability-orientated innovation devoted to assisting organizations in adopting sustainable strategies and practices that depend on innovations (Klewitz & Hansen, 2014; Greco et al., 2021). Innovation capabilities perform various vital functions in the survival and sustainability of businesses, enabling them to reconstruct, develop, grow, or sustain themselves through renewal and new beginnings. Prior research also confirms the role of innovativeness in value creation, facilitating the management of long-term sustainability challenges (Laasch, 2019; Bocken & Geradts, 2020). Lo et al. (2021) emphasize the role of innovation capabilities in enabling organizations to develop longer-term sustainable value propositions. The COVID-19 literature has emphasized the role of innovation capabilities in maintaining sustainability through responding fast and working in novel ways in reaction to challenges posed by the pandemic (Ivanov, 2020; Sarkis, 2020; Corrêa et al., 2021). Similarly, collaborative innovation has been acknowledged as a major enabler of organizational agility in responding both to unpredictable short-term emergencies and long-term crises (Blomqvist & Levy, 2006; Wang et al., 2017).

Bocken and Geradts (2020) emphasize the need for collaborative innovation to enhance dynamic organizational capabilities in addressing business sustainability challenges. Many studies have also regarded innovation as a significant determinant of firms' continuous growth (Malmström & Johansson, 2015; Mu et al., 2019). In today's complex business environment, scholars underline the value of collaborative innovation as a fundamental resource for enhancing business performance and longstanding success, thus maintaining

sustainability (Heil & Bornemann, 2018; Krishnan et al., 2021; Shen et al., 2021). Collaborative innovations are renewable sources of superior performance and survival strategy in turbulent and unpredictable changing environments. They allow businesses to innovate new products, services, and operations, thus exploiting opportunities and reducing potential risks and threats. Wang et al. (2020) emphasize that during the COVID-19 crisis, collaborative innovation has created novel solutions to deal with sustainability threats.

With the advent of social computing, recent studies have started to pay more attention to open collaborative innovation, involving the public, as an effective strategy to address sustainability challenges. Participants use their creativity, skills, and experience in providing novel solutions for predefined challenges. Prior research has found that such a strategy assists businesses in addressing sustainability through gaining a better understanding of market needs and expectations and how to co-create value for all participants involved (Mu et al., 2019; Greco et al., 2021). Collaborative innovation also allows firms to share innovation costs and reduce uncertainty. Such collaboration is significant in the early stages of innovation projects, where uncertainty and risk are high. It empowers firms to mitigate these risks and uncertainties (Malmström & Johansson, 2015). Therefore this study hypothesizes:

H6. Collaborative innovation significantly impacts organizational sustainability.

Methodology

Measuring research constructs and developing instrument

The empirical part of this study used an online questionnaire. Questionnaire items were adopted from prior related studies (Table 1) on social capital, collaborative innovation, collective intelligence and organization sustainability.

Three experts—in knowledge management, innovation management and organizational performance—helped to validate the survey instrument for clarity, logical consistency and relevance context. Measuring items were purified and modified based on the experts' feedback Table 2. displays the questionnaire items. The thirty-four items were measured on a 5-point Likert scale from "strongly disagree = 1" to "strongly agree = 5".

Sampling and data collection

Because the current study examines collaborative innovation, collective intelligence and organizations' sustainability and survival in the Covid-19 crisis, it was reasonable to select the population from firms that could continue, initiate competitive superiority and recover from this crisis. To ensure the homogeneity of the population and identify its frame, the 46 top Jordanian manufacturing firms of 2021 were selected to conduct this study. This population was

derived from the international 'BestStartup.Asia' list of the best companies across Asia (<https://beststartup.asia/category/western-asia/jordan/>). Manufacturing firms have multidimensional and diverse relationships with many business partners, including suppliers, logistics companies, and distribution channels. This necessitates collaboration and information-sharing about market supply and demand, orders, production, inventory, and product delivery.

After exploratory telephone interviews, 27 firms agreed to join this study Table 3. presents the participant profile.

In order to reach the largest possible number of respondents, printed questionnaires were distributed to firms that agreed to distribute the questionnaire by hand. A telephone survey and direct e-mail were also used, exploiting information published on the firms' websites. However, the questionnaire distribution resulted in 232 usable cases for analysis.

Data analysis

Being quantitative, our study used SmartPLS to analyze the data, including assessing research model reliability and validity and testing hypotheses.

Measurement model assessment

To adjust the research instrument and purify its measurement scale, items with factor loadings < 0.70 were removed from the scale to improve model and path strength (Hair et al., 2014). One item from each of social capital (SC5) and organizational sustainability (OS6) was excluded from the measurement scale. Internal consistency and reliability (Table 4) met the measurement criteria threshold. Cronbach's alpha in the measurement model assessment is > 0.80 for all constructs. Composite Reliability (CR) exceeded the threshold of 0.80. The results of the Average Variance extracted (AVE) of all constructs is also above threshold, > 0.5, confirming convergent validity.

According to Fornell-Lacker's (1981) criterion, Table 5 confirms that the discriminant validity of the research model has been achieved.

The structural model assessment and testing hypotheses

The analysis outcomes of the Smart PLS paths are shown in Fig. 2. These results show that social capital predicts 28.6% of the variances of collective intelligence. They also show that social capital and collective intelligence account for 51.5% of the variances of collaborative innovation. The structural model shows that social capital, collective intelligence, and collaborative innovation predict 59.1% of the variances of organizational sustainability.

Table 6 shows that social capital significantly impacts collaborative innovation (H1), collective intelligence (H2), and organizational sustainability (H3).

Collective intelligence significantly impacts collaborative innovation (H4) and organizational sustainability (H5). Collaborative innovation impacts organizational sustainability significantly (H6).

Discussion

The results show that social capital significantly impacts collaborative innovation. These findings agree with the literature (e.g., Malmström & Johansson, 2015; Jiao et al., 2019) that establishing strong ties with business partners through social interactions is a critical determinant of collaborative innovation. They are also in line with studies (e.g., Blomqvist & Levy, 2006; Pérez-Luño et al., 2011; Steinmo & Rasmussen, 2018), confirming that the social capital approach can explain the effects of external and internal relationships on innovation.

Table 1
Measurement sources.

Construct	Code	No. of Items	Refs.
Social capital	SC	6	Pérez-Luño et al. (2011); Gölgeci and Kuivalainen (2020).
Collaborative innovation	CIN	5	Ghassim and Bogers (2019), Jiao et al. (2019)
Collective intelligence	CI	6	Al Omoush (2018); Mignenan (2021).
Organisation sustainability	OS		Ivanov (2020), Greco et al. (2021), Lo et al. (2021)

Table 2
Constructs and questionnaire items.

Construct	Code	Measurement Items
Social capital		<i>Indicate the level of agreement that your firm:</i>
	SC1	Is well connected to its business partners.
	SC2	Obtains required resources and capabilities using its business networks.
	SC3	Has close relationships and collaborative activities with other firms.
	SC4	Has strong ties with business partners, including a high degree of trust and commitment.
	SC5	Acquires and leverages value-added knowledge from its business networks.
Collaborative innovation	SC6	Social networks influence its strategy, decisions, processes, and activities.
		<i>Indicate the level of agreement that collaboration with business partners during the COVID-19 crisis has enabled your firm to:</i>
	CIN1	Improve existing products, services, and/or processes.
	CIN2	Introduce new products, services, and/or initiatives.
	CIN3	Get innovative ideas and creative solutions when solving problems.
Collective intelligence	CIN4	Gain new knowledge.
	CIN5	Adopt novel information technology solutions.
	CI1	Attain deep collective thinking, understanding, and sharing perceptions and perspectives.
	CI2	Obtain a repository of information and knowledge for current and future uses.
	CI3	Employ collective intelligence to identify problems and evaluate ideas and alternatives about priorities and solutions.
	CI4	Collectively share and create new knowledge and experience.
Organisational sustainability	CI5	Develop and exchange best practice.
	CI6	Enhance continuous collective learning capability from business environments and business partners.
		<i>Indicate the level of agreement that your firm was able during COVID-19 to:</i>
	OS1	Improve its image and existence in society.
	OS2	Improve productivity.
	OS3	Increase profits.
	OS4	Sense dynamic changes posed by the epidemic and respond quickly.
OS5	Adapt resources and capabilities in an agile way to meet market-changing needs during the pandemic.	
	OS6	Support the survivability of business partners during the crisis.
	OS7	Maintain supply chain resilience and sustainability.

The findings underline the significant impact of social capital on collective intelligence. They are compatible with earlier studies (e.g., Dellermann et al., 2020; Mignenan, 2021) that described collective intelligence as a kind of socially constructed co-creation. They also agree with studies that confirmed the function of social capital in achieving some of the features of collective intelligence such as collective memory, collective cognition, knowledge sharing and collective learning (e.g., Gan & Zhu, 2007; Ng & Liang, 2010; Secundo et al., 2016).

The findings provide evidence that social capital significantly impacts organization sustainability. They agree with previous findings (e.g., Gligor et al., 2013; Gölgeci & Kuivalainen, 2020) that social

capital is a strategic organizational asset for firms seeking superior sustainable performance, sustained value creation and a sound basis for business survival and sustainability. Many authors (e.g., Hormiga et al., 2011; Zhao & Burt, 2018; Prokop et al., 2019) have emphasized that higher levels of relational capital and the ability of firms to leverage business networks connectivity with partners are related to higher levels of success and sustainability. These findings also agree with Mubarik et al. (2021), who show that organizations with well-integrated social capital have been more successful in mitigating the effects of COVID-19, improving their chances of recovery and survival.

The results demonstrate the impact of collective intelligence on successful collaborative innovation. They are compatible with findings (e.g., Lykourantzou et al., 2011; Mignenan, 2021) emphasizing that crowdsourcing, a mechanism to achieve collective intelligence, is an excellent way of discovering innovative ideas. They also agree with Mignenan (2021), who showed that collective intelligence leads to wiser decision-making, the co-generation of novel ideas and the co-construction of creative solutions, all of which are at the core of the collaborative innovation process.

Table 3
The participant profile.

Firms	No	%	Respondents	No	%
Industry			Position		
Pharmaceutical	6	22	CEO	19	10
Food and drink	6	22	Sales & marketing manager/director	22	11
Healthcare	2	07	Operations/ manufacturing manager/director	22	11
Cleaning materials	3	11	IT manager/ director	20	10
Clothing	4	15	Quality manager/ director	15	08
Steel and iron products	3	11	Finance manager/ director	21	11
Others	3	11	Supply chain manger/ director	18	09
Firm size/ employees			Procurement/purchasing manager/ director	23	13
<250	5	19	Other managers	32	17
250–500	9	33	Education		
>500	13	48	Diploma or less	51	27
Firm age/ years			BA	107	56
>5	4	15	Postgraduate	34	18
5–10	9	33	Experience/ years		
11–15	3	11	>10	67	35
<15	11	41	10–20	81	42
Total	28	100	<20	44	23
			Total	192	100

Table 4
Validity and reliability of measures.

Constructs	Cronbach's alpha	CR	AVE
Social capital	0.823	0.871	0.575
Collaborative innovation	0.880	0.909	0.666
Collective intelligence	0.906	0.926	0.675
Organisational sustainability	0.871	0.901	0.605

Table 5
Discriminant validity.

No.	Constructs	1	2	3	4
1	Social capital	0.758			
2	Collaborative innovation	0.573	0.816		
3	Collective intelligence	0.534	0.571	0.822	
4	Organisational sustainability	0.616	0.626	0.698	0.778

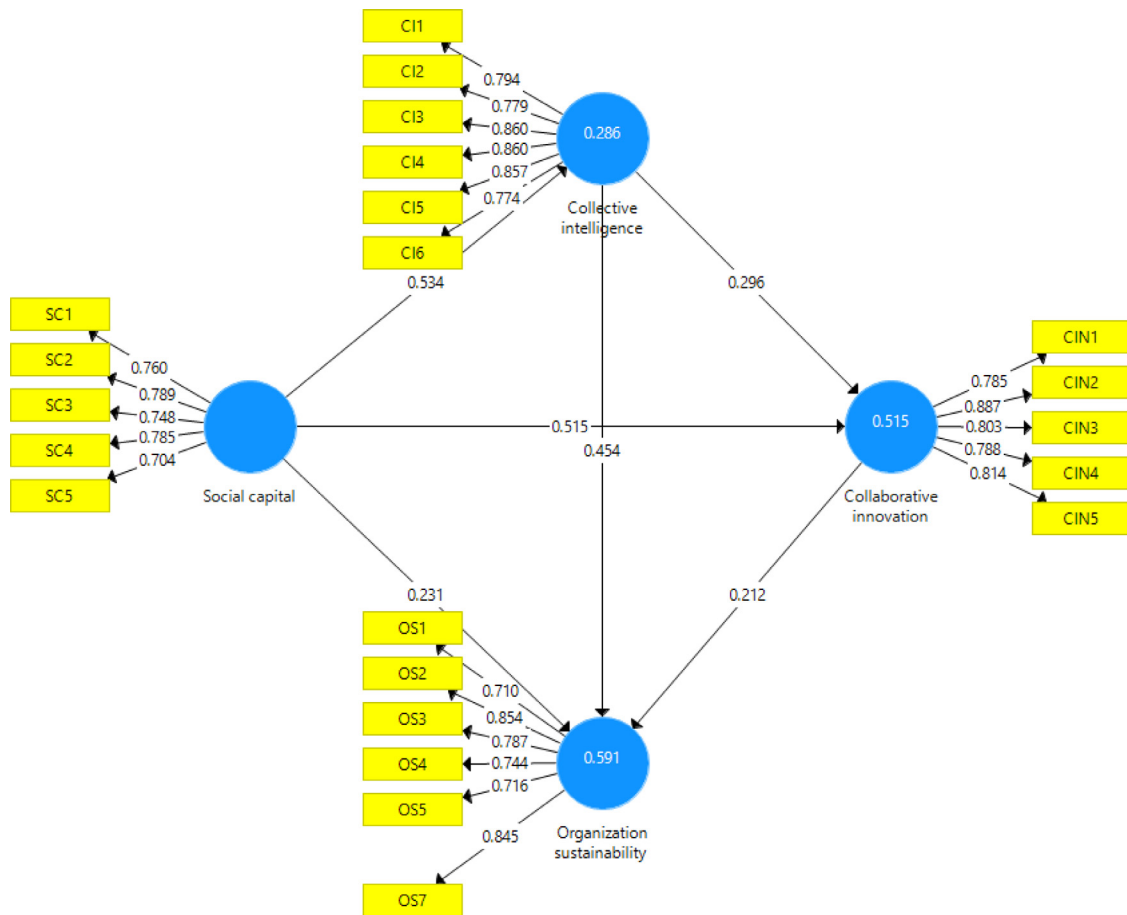


Fig. 2. Path analysis.

The findings also show that collective intelligence significantly impacts organizational sustainability. They accord with earlier studies (e.g., Garrido, 2009; Ng & Liang, 2010; Pór, 2014) that described organizations as complex adaptive systems that need to be intelligent enough to adapt and sustain themselves in unpredictable environments. Other studies (e.g., Ng & Liang, 2010; Secundo et al., 2016; Elia et al., 2020) have also regarded collective intelligence as a dynamic capability, required for building collective competence and increasing resilience in complex situations and rapidly changing environments. These results also agree with recent studies (e.g., Conroy & Deller, 2020; Elia et al., 2020) that found that collective intelligence is a necessary part of the roadmap to business sustainability.

Finally, the results reveal that collaborative innovation significantly impacts organizational sustainability. They agree with previous studies (e.g., Akçomak & Ter Weel, 2009; Klewitz & Hansen, 2014; Bocken & Geradts, 2020) that emphasized the

importance of innovation in the organizational competitiveness, agility, value creation and growth required for the maintenance of sustainability. They also agree with previous studies (e.g., Heil & Bornemann, 2018; Moretti & Biancardi, 2020; Shen et al., 2021) on the role of collaborative innovation in enhancing business performance and longstanding success, preserving its survival and sustainability. Studies of COVID-19 in particular (Ivanov, 2020; Sarkis, 2020) have emphasized the role of innovation capabilities in maintaining sustainability by facilitating fast responses and novel ways of working in the face of the challenges presented by the pandemic.

Conclusion and implications

COVID-19 has created threatening challenges for business survival and sustainability across all sectors and industries, forcing them to deploy their dynamic capabilities in sensing these challenges and responding innovatively. In the light of the COVID-19 literature gap, our study was an empirical examination of the role of social capital in creating collaborative innovation and collective intelligence and preserving organizational sustainability during the crisis. It also examined the role of collaborative innovation and collective intelligence in maintaining organizational survival and sustainability.

Our findings show that social capital significantly impacts collaborative innovation during crises. A firm that is well connected with business partners and has close relationships and collaborative activities with other firms is more likely to create collaborative innovation during unprecedented crises. The relationships of such firms with business partners are vital: they include a high degree of trust,

Table 6
Testing hypotheses.

Hypotheses	Paths	β	T values	P values	Results
1	SC CIN	0.515	7.800	0.000	Supported
2	SC CI	0.534	8.542	0.000	Supported
3	SC OS	0.231	3.077	0.002	Supported
4	CI CIN	0.296	4.259	0.000	Supported
5	CI OS	0.454	5.824	0.000	Supported
6	CIN OS	0.212	2.299	0.022	Supported

commitment, and cohesiveness. The use of these business networks allows them to obtain the required resources and capabilities for the co-creation of innovation. Superior social capital enables firms collaboratively to acquire or create value-added knowledge through business social networks, making for further novel innovations.

The results show that social capital significantly impacts collective intelligence in responding to the pandemic crisis. This implies that investing in social capital enables organizations to attain deep collective thinking, greater understanding, the sharing of perceptions and perspectives with business partners and the enrichment of their information and knowledge. Close relationships and cohesive business networks empower business partners to generate and practice collective intelligence through collaboratively identifying challenges and problems and evaluating ideas, priorities, and alternatives. This enables them to reach better solutions than those available to firms working independently. This social capital environment allows business partners to maintain their collective learning capability and to share and create together new knowledge, experience, and best practice: the core features of collective intelligence.

The findings also show that social capital has significantly impacted organizational sustainability during the COVID-19 crisis. They confirm that social capital, which develops reliable trust, commitment and cohesiveness with business environment actors through social business relationships and networks, plays a pivotal role in improving productivity, increasing profitability, and enhancing a firm's image and position in society during unprecedented crises. Firms with outstanding social capital were able to sense dynamic changes and respond quickly, maintain supply chain resilience and sustainability, and adapt resources and capabilities in an agile way to meet market-changing needs during the pandemic.

The findings confirm that collective intelligence significantly impacts collaborative innovation in responding to the pandemic crisis. Collective intelligence helps firms to improve existing products, services and processes and to introduce new ones. This dynamic intellectual capability generates new knowledge and provides innovative ideas and creative solutions when solving problems. Furthermore, collective intelligence enables firms to adopt novel information technology solutions, which often became the only way to communicate with business partners and the market under the pressure of the countermeasures and restrictions imposed to contain COVID-19.

The findings show that collective intelligence significantly impacts organizational sustainability during the pandemic crisis. They confirm that collective intelligence empowers firms to improve their image and position in society, thus preserving survival and sustainability during unprecedented crises. Collective intelligence improves a firm's efficiency, effectiveness and responsiveness to such crises. It enables firms to sense changes in the fast-changing, complex operating environment created by the epidemic and to respond quickly through their capacity for flexibility, agility, and renewal. In such an unstable environment, organizations are complex adaptive entities that must be intelligent enough to adapt and sustain themselves.

Finally, the results demonstrate that collaborative innovation significantly impacts organizational sustainability. Improving current products and services, introducing new ones, and gaining new knowledge through collaborative innovation promote survival and sustainability in unprecedented situations. Firms adopting novel information technologies enhance their ability to sense the dynamic changes posed by the epidemic and to maintain supply chain resilience and sustainability. Receiving innovative ideas and creative solutions from collective thinking and sharing perceptions and perspectives also enables firms to adapt their resources and capabilities in an agile way in order to meet market-changing needs during unprecedented situations, such as pandemic crises. The results also emphasize the role of

collaborative innovation in improving productivity and increasing profit, which contributes significantly to organizational survival and sustainability during crises.

The study contributes many valuable insights to the literature of social capital, collective intelligence, collaborative innovation and organizational sustainability during crises and unprecedented situations. It provides empirical evidence on the role of social capital in promoting dynamic capabilities during challenging, unprecedented situations. The paralysis of the lives of many who depend entirely on firms' goods and services has prompted us to re-examine the determinants of firms' survival and sustainability during unprecedented crises, particularly their dynamic capabilities. No empirical research had previously studied the causal relations among social capital, collective intelligence, collaborative innovation, and organization sustainability in general and during global crises in particular. This study illuminates the role of social capital in generating collective intelligence and collaborative innovation in responding to the challenges posed by COVID-19. It also contributes to our understanding of how social capital, collective intelligence, and collaborative innovation contribute to organizational survival and sustainability in unprecedented crises. Moreover, it enriches the literature on dynamic capabilities by examining the relationship between collective intelligence and collaborative innovation under the pressures of such crises.

Our results will assist practitioners, particularly in employing their dynamic capabilities to maintain organizational survival and sustainability in exceptional conditions and unprecedented crises. They provide managers with an effective mechanism to respond to future crises through investing in social capital and dynamic capabilities, preserving their organizations' survival and sustainability. They will help managers generate and employ collective intelligence and collaborative innovation during unprecedented crises. Firms need to develop their social capital, collective intelligence, and collaborative innovation capabilities early, in times of prosperity and stability, to preserve their survival and sustainability in crises and difficult situations. Business partners need to collaborate and integrate their capacities for intelligence and innovation in order to address the threats and challenges of severe crises. The research model used here presents a paradigm of how to maintain firms' sustainability and continuity in an exceptionally turbulent environment. It will also help organizations increase their awareness of how to recover from the COVID-19 crisis quicker than their competitors.

Although this study has offered valuable insights into the relationships among social capital, collective intelligence, collaborative innovation, and the maintenance of organizational sustainability during the COVID-19 crisis, it still has limitations. Firstly, it was confined to Jordan, meaning that the results are not generalizable to the manufacturing sectors of other countries. Future studies should be conducted in other countries and sectors, with larger sample sizes, to obtain comparative results. Secondly, this study has ignored the impact of firms' characteristics on the social capital, collective intelligence and collaborative innovation levels. Future studies should therefore consider characteristics such as ownership, size and age. Thirdly, although information technology has been fundamental to the release and development of collaborative capabilities, including collective intelligence and collaborative innovation, this study did not address this technology in detail. Therefore future studies should examine the role of information technology in empowering these capabilities and maintaining organizational sustainability.

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