Strategic supplier relationships and supply chain resilience: Is digital transformation that precludes trust beneficial?

Abstract

Purpose – The purpose of this study is to investigate the role that communication, trust, and digital transformation can play in the relationship between joint problem solving and supply chain resilience. More specifically, we try to examine the possibility of digital transformation as a replacement for trust within a joint problem solving context.

Design/methodology/approach – A survey instrument was developed and administrated to manufacturing firms within the United Kingdom and the United States. Based on data collected from 291 senior managers, multiple linear regressions were conducted through a customized Process model to test the proposed hypotheses.

Findings – The results point to the actual impact of digital transformation being far more complicated than the initial benefits that it appears to bring within a supply chain. Thus, technology is only effective when applied within the right context. We showcase that the trio of digital transformation, trust and joint problem solving can be highly valuable to establish supply chain resilience and that further investigation on the interrelationships between these concepts is warranted.

Practical implications – Manufacturing firms that aim to adopt new technologies should not consider advanced digital technologies as an alternative to trust. While digital transformation can improve resource sharing and integration, governance mechanisms – such as trust – will remain the cornerstones of strategic supplier relationships. Therefore, supply chain partners must strive to achieve a balance between trust and the right type of digital technology.

Originality/value – This study contributes to the growing literature focusing on the role that digital transformation can play in developing supply chain capabilities. It adds an early empirical insight on the role of technology and governance in joint problem solving and supply chain resilience.

Keywords – Resilience, Digital transformation, Trust, Joint problem solving.

1. Introduction

Extensive growth in global connectivity and offshore operations have led to sensitive and complex supply chain networks which are overwhelmingly susceptible to disruptions (Blackburn, 2012; Williams *et al.,* 2013). At the same time, disruptions are also getting a little too frequent and impactful (Azadegan *et al.*, 2020; Revilla and Saenz, 2017). In just the last five years, we have evidenced floods in Thailand, fire in apparel factories in Bangladesh, Brexit, US-China trade war, and the COVID-19 pandemic, to name a few; whether isolated or wide-spread, these events disrupt global supply chains in an unprecedented and unpredictable manner. Disruptions of such magnitude clearly emphasize the importance of resilience at the supply chain level, especially for firms that have a global footprint (Azadegan *et al.*, 2020). Specifically, due to the massive size and complex nature of the current global supply chains, no single firm is equipped with all the required resources to manage risk or disruption. Thus, supply chain level resilience that is developed through collaboration with external partners (in our case, suppliers) is extremely valuable and essential (Scholten and Schilder, 2015).

Supply chain resilience (SCRES) represents a set of capabilities that could help firms to not only recover from disruptions, but also prevent their occurrence, if possible (Brandon-Jones *et al.*, 2014; Tukamuhabwa *et al.*, 2015). Therefore, any capability that helps a supply chain to proactively prepare for expected disruptions or appropriately react to mitigate the effects of unexpected disruptions could fall within the realm of SCRES (Hora and Klassen, 2013; Kleindorfer and Saad, 2005; Sodhi *et al.*, 2012; Tukamuhabwa *et al.,* 2015). Extant literature has forwarded different capabilities including response capability, visibility, warning capability, recovery, agility, flexibility, robustness, and redundancy to underpin the notion of SCRES (Ambulkar *et al.*, 2015; Tukamuhabwa *et al.*, 2015). At the same time, extant literature has often operationalized SCRES using only one such isolated capability (Brandon-Jones *et al.*, 2014; Gligor *et al.*, 2015; Sawhney, 2013). But scholars question such an approach due to the understanding that SCRES is a much more complex and interconnected multifactor capability (Bernardes and Hanna, 2009; Brusset, 2016; Srinivasan and Swink, 2018). Against this backdrop, this study adopts a more inclusive measurement for SCRES.

Building SCRES capabilities to contend with ever-increasing disruptions requires higher levels of resource availability as well as knowledge intensity (Azadegan *et al.*, 2020; Im *et al.,* 2019). It is unlikely for a firm to possess all the required resources, insights and experiences needed to develop a multifaceted SCRES. Therefore, as per the tenets of the relational view, collaborative supplier relationships are essential for developing stronger SCRES capabilities (Durach and Machuca, 2018; Scholten and Schilder, 2015; Scholten *et al.,* 2014). Relational view also contends that such collaborative relationships are increasingly managed using relational governance mechanisms (Dyer and Singh, 1998). Joint problem solving (JPS) is one such relational governance mechanism that could clearly signal the presence of close and collaborative relationships with suppliers (Heide and John, 1990). In this research, we study the central role of JPS because it is considered instrumental in the sharing as well as development of tacit and explicit resources to address problems and opportunities within a collaborative buyer-supplier relationship (BSR) (McEvily and Marcus, 2005; Zaheer and Venkatraman, 1995). JPS initiatives could also ensure access to complementary resources, insights, and expertise that might not be otherwise available within the firm (Dyer and Singh, 1998; Scholten and Schilder, 2015).

The success of JPS efforts is contingent upon the presence of trust and communication within the exchange relationship (Zaheer and Venkatraman, 1995). Scholars argue that JPS is intensely driven and guided by the presence of relational trust (Dyer and Chu, 2003; Hagen and Choe, 1998; Lewicki *et al.*, 1998; McEvily and Marcus, 2005; Zaheer and Venkatraman, 1995). Additionally, given that communication personifies the presence of information sharing and connectivity, it is also considered essential for a collaborative JPS process (McEvily and

Marcus, 2005; Mohr and Spekman, 1994; Paulraj *et al.*, 2008). But are these effects still relevant in the current era of intense digital transformation (often referred to as Industry 4.0 and disruptive technologies)? This becomes a highly salient question given that digital transformation plays an instrumental role in restructuring our fundamental understanding of communication and trust within BSRs (Klein, 2007; Kumar *et al.*, 2020).

By improving communication and integration between supply chain partners, digital transformation expands the reach and impact of BSR (Kaufman *et al.*, 2000; Subramani, 2004). Based on the relational view, digital transformation facilitates both relation-specific assets and knowledge sharing routines to improve complementary resource sharing, which could lead to relational advantages (Dyer and Singh, 1998; Dyer *et al.*, 2018). Extant literature also goes to the extent of suggesting that digital transformation can reshape the propensity of JPS as well as reinforce SCRES by standardizing information capture, simplifying communication, and improving transparency and traceability (Akkermans *et al.*, 2003; Bode and Macdonald, 2017; Kotabe *et al.*, 2003). Alternatively, informal governance mechanisms like trust are historically considered to be valuable in making JPS impactful (Dyer and Singh, 1998; Dyer *et al.*, 2018; McEvily and Marcus, 2005; Zaheer and Venkatraman, 1995). Moreover, JPS represents a specific context wherein trust could play a crucial role and facilitate the seamless transfer of tacit knowledge and expertise (McEvily and Marcus, 2005; Mohr and Spekman, 1994). Therefore, is trust redundant or relevant for JPS under the wave of digital transformation?

This dilemma is not just theoretical. Looking at the breakdown of United kingdom's KFC fast-food shops in 2018, can help us conceptualize our research context. KFC set up a new logistics collaboration with DHL after terminating its contract with Bidvest logistics because DHL offered a more technologically advanced solution at a lower cost. Immediately after the transition, the supply chain broke down and caused a nationwide KFC store shutdown, for almost the whole of February, due to the lack of supply of chicken. Even after multiple assurances about recovery from DHL, KFC still entered into a new contract with Bidvest logistics. Subsequently, all three parties worked together to bring stability to the supply of chicken. Thus, one could argue that KFC needed both technology (i.e., DHL) and a trusted relationship (i.e., Bidvest logistics).

Additionally, during the COVID-19 pandemic, the digital transformation has impacted almost every industry. From higher education to home delivery, digitalization is bringing business partners together to address the problems in the supply chain. While universities are working with teleconference solution providers to conduct classes, restaurants are working with dark kitchen facilities and home delivery companies to bring everything on one platform. However, is this joint effort only driven by the availability of disruptive technologies or is trust in the relationship driving these JPS or is it both? Specifically, the question "can digital transformation suppress the need for interorganizational trust through unified, standardized connectivity?" remains largely unanswered. Against this backdrop, we adhere to the relational view and explore the role of communication, trust, and digital transformation on the relationship between JPS and SCRES.

By empirically exploring these hypothesized relationships, our study makes invaluable contributions to extant research on SCRES. First, given that a supply chain cannot be considered resilient by relying on a single capability, conceptualizing SCRES as a combination of four interconnected capabilities (visibility, agility, flexibility, and recovery) is one of the unique contributions of this research. Extant literature suggests that these capabilities drive each other (Bernardes and Hanna, 2009; Tukamuhabwa *et al.*, 2015). Accordingly, measuring SCRES as a second-order variable reflecting these capabilities could help in understanding SCRES in a much more practical way. Second, firm-level resilience capabilities are not sufficient within a highly connected supply chain (Sá *et al.*, 2019). In other words, collaborative BSR is an essential element of SCRES. While different aspects of collaboration could impact

SCRES, to the best of our knowledge, the influence of JPS on SCRES is not covered in extant literature. With intensifying disruptions, JPS is gaining more attention among scholars (Kaufmann *et al.*, 2018). Accordingly, our study makes an invaluable contribution by addressing the key role of JPS. Third, digital transformation causes lasting changes in how supply chains synthesize solutions for problems (Ralston and Blackhurst, 2020). Studying the role of digital transformation on SCRES could thus provide a holistic understanding into the phenomenon. This research makes a timely contribution by addressing both digital transformation and SCRES within the context of BSR. Finally, our findings indicate that technology can facilitate relational trust, but cannot replace it. In the context of JPS, we argue that trust will always be needed regardless of a technological shift. We contend that this is a significant insight about informal governance in BSRs that are witnessing an increased digital transformation. We also believe that our study could serve as a basis for further investigation into the effectiveness of governance mechanisms in the age of digital transformation.

2. Literature review and hypotheses construction

2.1. Supply chain resilience

Resilience, often considered as an inclusive concept, can be defined as the ability of a firm and/or supply chain to prepare for and respond to disruptions so as to get back to the original, or even perhaps a better state (Sá *et al*., 2019; Tukamuhabwa *et al*., 2015). Supply chain resilience contains multiple interconnected capabilities; these multiple capabilities are necessary for a robust conceptualization of SCRES (Chiang *et al*., 2012). In this research, we envision SCRES as a second order measurement that captures its multi-capability nature. Specifically, we conceptualize SCRES using four capabilities – visibility, agility, flexibility, and recovery – that are well-connected and strongly dependent on each other conceptually (Brandon-Jones *et al.*, 2014; Dubey *et al.,* 2018; Gligor *et al.*, 2015; Tukamuhabwa *et al.,* 2015). Additionally, these four capabilities are quite popular in empirical research and have been established to exhibit strong internal connectivity (Bernardes and Hanna, 2009; Dubey *et al.*, 2018; Juttner and Maklan, 2011; Tukamuhabwa *et al.*, 2015). Our conceptualization of SCRES also adheres to the methodological norm that the first-order variables have a strong similarity or connection among themselves (Brookings and Bolton, 1988; Doll *et al.*, 1994).

Supply chain visibility is an essential element of resilience research (Swift *et al.*, 2019). Visibility is basically shared information which allows partners within a supply chain to access essential information within the supply chain (Barratt and Oke, 2007). Visibility, considered as a proactive resilience capability (Tukamuhabwa *et al.*, 2015), can make a potential supply chain disruption noticeable; in doing so, it allows firms to take preventive actions or to set reactive measures (Juttner and Maklan, 2011; Scholten and Schilder, 2015). Often, visibility is closely associated with and considered as a precondition for supply chain agility (Brandon-Jones *et al.*, 2014; Dubey *et al.*, 2018). Research has shown that supply chain visibility could enhance firms' risk assessment capability (Srinivasan and Swink, 2018), thereby eventually leading to agile and flexible operations (Juttner and Maklan, 2011).

An agile operation reflects a system that can cooperate and innovate to generate flexibility, speed, and efficiency; this is done in a manner such that operations continue seamlessly even in a dynamic business environment (Gligor *et al.*, 2015; Vazquez-Bustelo *et al.*, 2007). Similarly, flexibility is the ability to respond or adapt effectively to changing conditions (Gerwin, 1987). Both agility and flexibility have been researched extensively within the supply chain performance and resilience context (Gligor *et al.*, 2015; Tukamuhabwa *et al.*, 2015). However, to establish SCRES, agility and flexibility are both often required (Chiang *et al.*, 2012). While literature suggests that agility and flexibility are interdependent, they are neither synonymous nor substitutional (Bernardes and Hanna, 2009). Agility and flexibility can be effective both during disruption as well as during the post-disruption period; together, they can facilitate a stronger recovery from disruptions (Tukamuhabwa *et al.*, 2015).

Although recovery strategies need to be considered long before disruption, they could come in handy from pre-disruption to post-disruption (Azadegan *et al.*, 2020). Since recovery capabilities involve planning and preparedness, they are also connected with a firm's flexibility in resource and operational management (Azadegan *et al.*, 2020). Moreover, recovery is the final step of SCRES; agility and flexibility will not be effective in a supply chain that lacks recovery planning and strategy (Azadegan and Dooley, 2010).

2.2. Hypotheses development

JPS is a process-oriented capability which can be defined as the level of joint involvement among the supply chain partners to ensure status quo in daily operations as well as to solve problems and/or disruptions along the way (McEvily and Marcus, 2005; Zaheer and Venkatraman, 1995). JPS can play a valuable role in complementary resource sharing (McEvily and Marcus, 2005). It is also a pivotal process that could be used to safeguard supply chain partners' investments in the relationship and to reduce the risk of noncompliance (Zaheer and Venkatraman, 1995). Apart from reducing risks and cost, JPS could also improve the performance of the supply chain partners (Power and Singh, 2007). Literature indicates that such collaborative capabilities within BSR are broadly beneficial for disruption management within diverse contexts (Revilla and Saenz, 2017).

Communication is essential to develop other higher-level collaborative capabilities such as JPS (Droge *et al.*, 2004). Generally, communication could represent the transmission of tacit and explicit resource sharing between supply chain partners (Scholten and Schilder, 2015). Communication is often considered as the first step for interorganizational connectivity, fostering and maintaining value-enhancing BSR, and improving buyer-supplier performance (Mohr and Spekman, 1994; Paulraj *et al*., 2008). If communication is the inception of BSR, then JPS could be considered a higher level of collaboration (McEvily and Marcus, 2005;

Scholten and Schilder, 2015). In other words, theoretically, communication could be considered a significant precursor to JPS efforts.

According to the relational view, communication and connectivity are processes through which supply chain partners can share experience and knowledge (Dyer and Singh, 1998; Dyer *et al.*, 2018). Inter-firm communication should not be limited to firm-level formal connectivity. Instead, a higher degree of knowledge transfer in the BSR can be facilitated by social or relational aspects of communication (Carr and Pearson, 1999; Li *et al.*, 2014). Communication ensures the flow of timely, accurate and relevant information to help the supply chain partners stay vigilant (Chen and Paulraj, 2004; Paulraj *et al.*, 2008); as per the relational view, this is crucial for not only any problem-solving effort, but also for the transfer as well as creation of specialized knowledge (Dyer *et al.*, 2018). Continued communication is key to the use of tacit knowledge and experience to support JPS efforts (Nahapiet and Ghoshal, 1998). The flow of information and the ability to leverage communication can significantly boost the cooperative nature of the relationship (Lawson *et al.*, 2008), which can subsequently accelerate the understanding of any problems that the partners might encounter. This can further trigger the willingness for not only sharing insights, but also participating in JPS efforts. Additionally, communication is also essential for problem identification, including raising a flag or spotting an operational error. In summary, the sharing of knowledge and experience facilitated through communication could significantly enhance JPS efforts. Therefore:

H_1: Communication will have a positive impact on JPS capabilities.

JPS efforts can strongly influence the development of other capabilities (McEvily and Marcus, 2005). More importantly, leaving a partner unattended in a problematic condition can make the core of any relationship weaker and could put the whole supply chain at the risk of failure. Accordingly, JPS has the unique ability to provide win-win solutions or mutually coherent strategies (Claycomb and Frankwick, 2010), thereby leading to stronger resilience within the entire supply chain. Joint efforts in solving problems could give the partners more confidence in the relationship and the firms' collective capability. Working with supply chain partners in such efforts can provide multiple vantage points for the partnering firms to objectively evaluate problems and decide the best course of action for being resilient. JPS could also provide a platform to learn best practices from expert supply chain partners (McEvily and Marcus, 2005). Accordingly, JPS becomes a value creation tool and provides the partners with a strong sense of belonging.

As espoused by the relational view, the most critical value JPS can bring is decision making and problem-solving experience along with the related tacit knowledge. Experiences are hard to transfer or codify, and at the same time, are essential for resilience capabilities. The quickest way to gain such capabilities from supply chain partners is by working together; transfer of detailed tacit knowledge could eventually enhance the accuracy of resilience management (Im *et al.*, 2019; McEvily and Marcus, 2005). All the available experience and physical complementary resources in BSR can collectively enhance supply chain capabilities (Dyer and Singh, 1998; Dyer *et al.*, 2018). Capabilities like visibility, agility, flexibility and recovery are all highly resource dependent; by improving the focal firm's access to the additional resources from its partners, JPS could significantly improve resilience capability of the whole supply chain (Brandon-Jones *et al.*, 2014; Cheng and Lu, 2017; Li *et al.*, 2014; McEvily and Marcus, 2005; Scholten and Schilder, 2015). Given that JPS enhances the flow of information, it can ensure higher visibility in the supply chain. Similarly, agility and flexibility both get extensively benefited from the strong collaboration facilitated by JPS (Narayanan *et al.*, 2015; Stevenson and Spring, 2007). Finally, with access to more resource and information, JPS can ensure faster recovery from disruptions. In other words, JPS can play a key role in improving all the collective capabilities that we use to underpin SCRES. Based on these arguments, we hypothesize:

H_2: JPS capabilities positively influence SCRES capabilities

Trust, an informal and/or relational governance mechanism, is considered important for not only a stable and long-term relationship, but also for a continued interfirm exchange of relational assets (Dyer and Singh, 1998; Zaheer and Venkatraman, 1995). While there are many dimensions of trust that is forwarded by extant literature, we adhere to the relational view and focus on goodwill trust as an informal governance mechanism (Dyer and Singh, 1998; Zaheer and Venkatraman, 1995). Our conceptualization of trust includes two key dimensions – credibility and benevolence (Bode *et al.*, 2011). We have used goodwill trust as it signifies the strength and depth of the exchange relationship. Establishing significant trust in inter-firm relationships can increase the effect of communication and cooperation for any purpose (Carr and Pearson, 1999). Moreover, trust helps BSR by giving the exchange partners the confidence to not question each other's motivation (Dyer and Chu, 2003). Therefore, when a supply chain faces disruption and there is a possibility that a partnering firm might choose to ignore collective benefit to control internal damage, the informal safeguards provided by trust becomes specifically crucial at that moment to rather prompt JPS efforts. Accordingly, goodwill trust is valuable in enhancing the effect of communication on JPS. Additionally, trust between partners is crucial for them to believe that they are doing what is best for the supply chain and will not overlook collaborative advantage (Bode *et al.*, 2011; McEvily and Marcus, 2005). Within BSR, trust is also touted as a sociological as well as a psychological element to build up the relationship (Lewicki *et al.*, 2016; Rousseau *et al.*, 1998; Zaheer and Venkatraman, 1995). Accordingly, without goodwill trust, the alarms from inter-firm communication may get ignored and communication could eventually lose its potential value within JPS efforts.

More importantly, partners with goodwill trust will have less/no hesitation in not only sharing, but also utilizing asymmetric information for JPS; on the contrary, lack of trust will be deleterious to information exchange and will diminish its impact on JPS (McEvily and Marcus, 2005; Mohr and Spekman, 1994). Trust can also bring mutual respect in a BSR; if one partner looks down on the other partner's ability and intention, then the relationship will not be able to perform efficiently even with the existence of proper communication. Moreover, communication can often get blocked by the dark sides of the relationship, like opportunism or conflict; these can dilute the strength of BSR and collective capabilities (Oliveira and Lumineau, 2019). As espoused by the relational view, in such situations trust could serve as a counteracting mechanism (Dyer and Singh, 1998; Dyer *et al.*, 2018). Accordingly, we hypothesize that trust will positively moderate the effect of communication on JPS.

However, we do not consider trust as a moderator of the path between JPS and SCRES. As a relational governance mechanism, trust is envisioned to play a key role when it comes to the effect of communication on JPS (Dyer and Singh, 1998; Zaheer and Venkatraman, 1995). Since trust can help to develop long-term and secure relationships (Rousseau *et al.*, 1998), it is essential to develop JPS, which is categorized as a process mechanism of collaborative BSR. On the contrary, the path from JPS to SCRES represents the application of a collective capability. Theoretically, it is impossible to get to the application stage of JPS without fostering relational trust throughout development of JPS efforts. Therefore, we believe that trust will stay inherent in the application stage only as a carry forward from the development of JPS capability. Accordingly, it would rather play an indirect or passive role in the application of JPS (Hill *et al.*, 2009; Tomlinson *et al.*, 2020). Therefore, we contend that studying the impact of trust on the relationship between JPS and SCRES is redundant. Therefore,

H_3: Trust will positively moderate the relationship between communication and JPS.

Given the radical change in the operational environment, supply chain operations are increasingly relying on technology for planning, information sharing and connectivity (Liu *et al.*, 2016). Supply chain technologies encompass tools or techniques that can enhance integration within as well as across firms (Autry *et al.*, 2010). The fourth industrial revolution, termed Industry 4.0, is mainly driven by advancements in communication and integration technologies; a large variety of technologies related to operations and supply chain is part of this Industry 4.0 (Queiroz *et al.*, 2020; Tortorella *et al.*, 2019). Most of these technologies are smart applications and machine-level connectivity tools like big data analytics, blockchain, artificial intelligence (AI), cloud-computing, internet of things, among others (Martinez *et al.*, 2019; Queiroz *et al.*, 2020). Supply chain integration can also be better facilitated with the use of technologies such as enterprise resource planning (ERP) (Li *et al.*, 2017).

Digital transformation not only drive innovation and competitive advantage (Kaufman *et al.*, 2000; Vanpoucke *et al.*, 2014), but also enhance connectivity to facilitate BSR and solve operational problems (Pu *et al.*, 2019). Issues like traceability and transparency within supply chains get quickly addressed by using connectivity technologies like ERP (Akkermans *et al.*, 2003). Problems like eco-friendly replenishment, scheduling, order management are significant in supply chain. Recent technological advancement on planning and communication provides a robust solution to these problems (Martinez *et al.*, 2019; Wang *et al.*, 2019). Additionally, digital transformation can also build a robust system around high-risk activities such as workflow designing and procurement functions, thereby mitigating the inherent risks (Cagliano *et al.*, 2019; Mishra *et al.*, 2013). More importantly, resilience capabilities like agility and flexibility can be better structured through the adoption of digital technology (Bernardes and Hanna, 2009; Cheng and Lu, 2017; Kaufman *et al.*, 2000).

Technological transformation can alter the business ecosystem altogether. Often, at the core of collaborative and innovative solutions to a business problem, there is always a technological platform that contains shared assets, standards, and communication interface (Dattée *et al.*, 2018). Theoretically, a buying firm could collaborate with technologically incompatible, yet essential, suppliers for routine functions. Still, such relationships may not be beneficial within the context of disruption because it often requires fast, compatible, and extensive interaction between the partners. On the other hand, joint collaborative work with a supplier that has similar technological capabilities will ensure higher problem-solving and SCRES capabilities (Kaufman *et al.*, 2000).

Through technological adaptations, firms have become well-integrated with supply chain partners without considering geographical distance as an impediment (Holmstrom *et al.*, 2019). Specifically, it has become easier to find the supplier that holds complementary resources and/or required expertise to solve a particular problem. At the same time, a system like ERP can vividly change the capabilities and capacity within BSR, thereby facilitating robust SCRES (Li *et al.*, 2017). Additionally, a technology-based connectivity could help partners with more communication channels (Arikan, 2009). Working with supply chain partners to solve an issue under a traditional supply chain setup could reduce visibility and traceability due to various sharing and resource-related barriers. Digital transformation can solve these problems by ensuring seamless connectivity (Hastig and Sodhi, 2020). This value addition could eventually result in improved JPS and SCRES capabilities.

Given that developing JPS capabilities could take a considerable amount of time, a young relationship may suffer from weaker JPS capability. But technology exchange can facilitate BSR by improving the power of combining capabilities regardless of the age of the relationship (Kotabe *et al.*, 2003). At the same time, gaining advantage of technology across the supply chain might also require investments in structural upgrades (Power and Singh, 2007). Such an investment will signal the partners' commitment to work together; this could subsequently facilitate JPS. On the other hand, ensuring resilience capabilities through BSRs also needs higher relational values. According to the relational view, firms with complementary resources can create better relational value through investing in relation-specific assets and knowledge sharing (Dyer *et al.*, 2018). Digital transformation provides not only increased resources for resilience capabilities, but also higher relational value that are developed through collective technological transformation. Accordingly, we believe that digital transformation can moderate the effects of communication on JPS as well as that of JPS on SCRES capabilities. Hence,

H_4: Digital transformation will positively moderate the relationship between communication and JPS.

H_5: Digital transformation will positively moderate the relationship between JPS and SCRES.

3. Methodology

3.1. Sample selection

We collected data from manufacturing firms operating in the United Kingdom (UK) and the United States of America (USA). Since theorization of this paper has an increased scope for generalizability, we ensured that the sampling frame could cover considerable diversity. At the same time, within a sampled firm, we had stringent guidelines for an acceptable respondent. Specifically, we targeted key respondents including senior executives (e.g., vice presidents, directors, and senior managers) of relevant areas such as operations, supply chain, and procurement. The ideal respondent needed to have a clear understanding of their company's overall supply chain as well as strategic relationship with suppliers.

3.2. Measures

This survey instrument was designed carefully by selecting reliable scales from extant literature. Throughout this process, we followed established guidelines from modern experts on survey design (Abbey and Meloy, 2017; Heggestad *et al.*, 2019;). This way of designing measurement instruments is a common practice to maintain content validity and contextual fit within social science research (Cronbach, 1971; Heggestad *et al.*, 2019; Mishra *et al.*, 2013). The measurement of all key constructs was done with a 7-point Likert scale having multiple indicators. Apart from the key constructs, several demographic-related questions as well as control variables were included in the questionnaire (Heggestad *et al.*, 2019).

Historically, SCRES has been measured in diverse ways through different indicators (Tukamuhabwa *et al.*, 2015). However, we operationalized SCRES as a second-order construct having four interconnected variables: visibility, agility, flexibility, and recovery. Visibility has been historically measured using two items (Brandon-Jones *et al.*, 2014; Dubey *et al.*, 2018); we adopted this scale from past literature. We used a five-item measurement for agility that has a BSR context (Dubey *et al.*, 2018). Flexibility has also been measured differently in past literature; we adapted a six-item measurement to assess how flexible the operation is to change and/or disruption (Kroes and Ghosh, 2010). Recovery has few useful measurement items available; we adapted a four-items scale drawing on Ambulkar *et al*. (2015) and Riley *et al.* (2016). JPS is a pivotal construct for this research; we adapted a six-item scale in context of disruption mitigation (Nyaga *et al.*, 2010). Communication was measured using a six-item scale which had a contextual fit regarding relational competency (Paulraj *et al*., 2008). Finally, we measured trust from both credibility and benevolence perspectives using a six-item scale closely related to the disruption/resilience context (Bode *et al*., 2011). As for digital transformation, we intended to focus on modern technologies which have a strong supply chain and/or interfirm perspective. Additionally, we were careful not to focus on any comparatively new technology that currently has little application in large scale manufacturing supply chains (e.g., augmented reality or 3D printing). After shortlisting 19 modern manufacturing-related technologies from current literature, we selected six which provided a considerably better fit within our research context (Li *et al*., 2017; Queiroz *et al*., 2020). A 7-point Likert having end points of “Not at all” and “Extensively” measured these items.

3.3. Control variables

JPS had six control variables while SCRES had four. Firm size and supply chain investment specificity were used as controls for both. The focal firm's size and industry type are some of the most common control variables used in SCRES research (Ambulkar *et al*., 2015; Poppo *et al*., 2016). Firm size was measured using the number of employees in the focal firm. Theoretically, as firm size increases the number of qualified personnel and thereby the level of tacit knowledge increases, and that can significantly influence the resilience strategies adopted (Grant, 1996). Similarly, the effectiveness of a resilience strategy can change across industries (Sá *et al*., 2019; Dubey *et al*., 2018). We controlled for seven different industry types. Given that an older firm should have more experience and knowledge (Bai *et al*., 2016), it can develop better resilience strategies. So, we also controlled for firm's age and used an open question to record it (in years). Finally, investment in supply chain assets or infrastructure can help to take SCRES measures easily across the supply chain. A single item seven-point scale ("Not at all" to "Extensively") was used to assess buying firm's investment specificity in supply chain (Stranieri *et al*., 2017).

JPS was also controlled for the focal firm's size. Buying firm's operational size influences its willingness and ability to collaborate with suppliers (Cao and Zhang, 2011; Scholten and Schilder, 2015). Another key control variable could be the supplier's relative size; this can influence the level of cooperation. A large supplier could hold relatively better resources and knowledge. Therefore, it could be more compelling for a buying firm to collaborate with larger suppliers. Similarly, it can also change the supplier's attitude or motivation (Liu *et al*., 2009). We measured the relative size of the supplier by measuring the employee count in supplier's firm over the employee count in the focal firm (Bai *et al*., 2016). Supplier's physical proximity to the focal firm can also influence the supply chain (Bray *et al*., 2019); therefore, it can also impact JPS. We measured physical proximity with a seven-point scale, anchored with very close to international (Stranieri *et al*., 2017). Literature indicates that a firm's disruption management capabilities can be influenced by relationship length (Bode *et al*., 2011). The number of years that the firm has been working with the supplier (Poppo *et al*., 2016) was used to measure relationship length. We also controlled for supplier importance as this can determine how a firm approaches its relationship with the supplier (Azadegan and Dooley, 2010; Poppo *et al*., 2016). We have used a two-item Likert scale with a seven-point anchoring (strongly disagree to strongly agree) to measure supplier's importance (Azadegan and Dooley, 2010). Investment specificity also can influence JPS capability; investing in the supply chain with key suppliers can enhance relational value and make the supplier willing to maintain alignment in JPS.

3.4. Data collection

We pretested the survey questions before data collection. Both industry and academic experts were invited to review the survey questions. We did this to ensure readability, interpretability, and structural accuracy (Swink and Nair, 2007). Based on the input received, some minor linguistic adjustments were made. Subsequently, we conducted a pilot study and collected 20 samples; after reviewing the data from this pilot study, we launched the survey for actual data collection in the early part of 2020. We used a survey research company for collecting survey data. Using professional data collection companies for survey administration is not uncommon in academic research; recently, this approach has been observed in multiple reliable supply chain and operations management research studies (Autry *et al*., 2010; Pu *et al*., 2019; Revilla and Saenz, 2017). In our research, we used a data collection firm for profiling the right sample, contacting them to request a response, and following up with selected respondents in the case of incomplete or no response.

Survey research firms are a feasible alternative to traditional survey approaches; extant literature has carefully considered the concern for quality and has pointed out that the response does not fluctuate between data collected by consulting firms and data collected using random mail if the target population is considerably knowledgeable about the research area (Autry *et al*., 2010; Pu *et al*., 2019; Schoenherr *et al*., 2015). While taking necessary precautions we employed stringent quality checks throughout the data collection process (Schoenherr *et al*., 2015). The survey instrument was equipped with multiple qualifying and quality assessment questions to ensure the quality of the respondents. By using appropriate qualifying questions, we ensured that the respondents held a relevant role within a manufacturing firm. Respondents had access to the main survey only after passing through the qualifying checkpoints.

In total, 1136 potential respondents were contacted. A total of 427 people responded and accessed the survey; after passing through the filtering process, 395 respondents completed the survey. We conducted an extensive quality check on these full responses; we removed all the responses with signs of poor attention or sincerity. We did not use any specific attention check questions because researchers in operations management and general social science have suggested that (1) such questions are not fundamentally robust and can often negatively influence respondents' perception, and (2) results are consistent with or without specific attention check questions (Kung *et al*., 2018; Shamon and Berning, 2020). Alternatively, we used other ways of filtering sincere responses (Abbey and Meloy, 2017). A respondent who rushes through the survey (quicker than one-third of the mean completion time) or provides a consistently similar response (like selecting all 7) was removed. After this comprehensive process, we arrived at a final sample of 291 responses, resulting in a 25.4% rate of response.

3.5. Bias countermeasures

We used a firm-level survey and collected data on both the independent and dependent variables from a single respondent within each firm. This approach could raise concerns regarding common method bias. Therefore, we used both procedural and methodological approaches to minimize as well as assess common method bias. First, our respondents are experienced and held mid/senior management positions; given that they possess relevant knowledge, some of the issues pertaining to single-source bias could be mitigated (Gligor *et al*., 2015; Mitchell, 1985). This bias was also addressed at the stage of survey design; dependent variables and independent variables were included in separate sections. Moreover, we also clarified that there is no desired right answer (Podsakoff *et al*., 2003; Tortorella *et al*., 2019). This technique helps to address self-reporting and social desirability biases. The questionnaire was also designed following acceptable standards and maintaining full anonymity so as to minimize social disability bias (Köhler *et al*., 2017; Liu *et al*., 2009; Podsakoff *et al*., 2003). Another strategy to mitigate social disability is to ask more specific, yet indirect, questions (Fisher, 1993); we followed this approach as well. Second, we conducted the most widely used Harman's single-factor test (Podsakoff *et al*., 2003; Podsakoff and Organ, 1986). Using confirmatory factor analysis, we ran a separate model with a single latent common method factor (CMF). CMF has loaded equally in all the relevant variables of that model; the model fit does not improve significantly. This establishes that any substantial bias owing to a common method is unlikely (Azadegan *et al.,* 2020; Bode *et al*., 2011; Dubey *et al.*, 2018; Paulraj *et al.*, 2017; Poppo *et al*., 2016). This conclusion was further confirmed using the Widaman (1985) approach; this approach compares the traits (theoretical factors) only measurement model to an alternative model that includes the method factor in addition to the traits (Podsakoff *et al*., 2003; Williams *et al.*, 1989; Paulraj *et al.*, 2008). Although our results indicate that the methods factor improved model fit marginally, it accounted only for 4% of the total variance; this is significantly lower than the amount of variance observed by both Williams *et al.* (1989) and Paulraj *et al.* (2008).

A lower response rate can always cast doubt regarding non-response bias. Research suggests that there is much similarity between participants who respond later and those who do not respond at all (Pace, 1939). Our collected data had a timestamp, so we separated the early responses from the late responses to test the non-response bias. The earlier response group had 170, and late response group had 121 samples. Group comparison tests showed little significant difference between the two groups in means and variations at $p<0.05$ (Chen and Paulraj, 2004; Pace, 1939; Paulraj *et al*., 2017; Tortorella *et al*., 2019).

4. Data analysis and results

The sample included almost equal number of firms from the United Kingdom and the United States of America. It covered key manufacturing sectors, namely industrial machinery (26%), light manufacturing (25%), food (10%), automobile (8%), appliances (7%), furniture (6%), apparel (5%) and other industries (12%). The sample also covered a variety of ownership (private, family, and public). In terms of age, we had coverage from growing businesses (under 20 years old - 41%) to matured businesses (more than 50 years old - 21%). In terms of firm size, we had a sizable representation of small-scale firms (22%) with less than 100 employees and almost half of the responses were from firms with 100 to 1000 employees (44%); rest were large firms.

4.1. Measurement validation

We followed standard procedures to check for reliability and validity. First, we ran the confirmatory factor analysis. Standardized factor loadings for measurement items are given in Table I along with the indicators (questions) used to measure the latent constructs. Table I also contains coefficient alpha, coefficient omega, composite reliability and average variance extracted. The model fit indices (Table I) indicate that the data fit the model well (Hu and Bentler, 1999). Except one, all variables used in this model have AVE value more than the threshold of 0.50 (Hair, 2019). The AVE for communication was 0.47; due to the context of the overall good fit of the model, this could be considered as acceptable (Lawson and Potter, 2012). Composite reliability values were higher than the required minimum limit of 0.80, thereby establishing convergent validity.

-- Insert Table I about here --

We checked for discriminant validity by comparing every pair of latent constructs to the respective square root of AVE values. The first part of Table II indicates that correlations between each pair of the constructs are lower than their corresponding square root of AVE (Fornell and Larcker, 1981), except in the case of communication and trust. However, this shortcoming could be solved by removing item 4 measuring the construct of communication (Table I). But given that (1) our results were consistent after the removal of this item, (2) the item has a significant CFA loading, and (3) it is a critical dimension that measures the strength of communication in relationships, we retained this item in our analysis. Additionally, we also conducted a more stringent analysis for discriminant validity to support our decision to retain this item. Specifically, we used the heterotrait-monotrait (HTMT) approach which is considered to be more reliable than the Fornell-Larcker's approach (Henseler *et al*., 2015). HTMT compares within-construct and between-construct correlations. The HTMT values for our constructs ranged between 0.41 to 0.81. Given that these values were lower than the limit of 0.85, we could conclude that our items exhibit discriminant validity.

Next, we used both coefficient alpha (Cronbach, 1971) and coefficient omega (McDonald, 1999) to evaluate reliability. Coefficient omega is purported to be the preferred measure of reliability (Deng and Chan, 2017; Revelle and Condon, 2019). We present both these coefficients in Table I; both coefficients were more than the required minimum of 0.80 for all the constructs. Additionally, when we assessed the confidence intervals of these coefficients, we found only two of the lower limits of omega were below 0.80 (but above 0.79 though). We also checked for robust alpha and robust omega (Zhang and Yuan, 2016); in both tests, our results are between 0.83 to 0.92. Based on these coefficients as well as the composite reliability scores, we could safely conclude that our measurement items are reliable.

-- Insert Table II about here –

All latent theoretical constructs that are part of our hypothesized model were created using the average score of their respective measurement items. Additionally, the second-order factor SCRES was derived based on the average score of its four first order factors. The summary statistics, along with the variables' correlation matrix, are given in Table II. In order to reduce nonessential multicollinearity, all variables used to create interaction terms were mean centered; this approach also helps to minimize ill-conditioning (Dalal and Zickar, 2012). For the full model, the individual variance inflation factor (VIF) value was below 2, implying that our results are unaffected by multicollinearity.

4.2. Hypotheses testing and Results

Our hypotheses were tested using a customized Process equation based on version 3.5 of the Process module (Hayes, 2018). This allowed us to run the conceptual model with two separate sets of control variables for the two endogenous variables. Figure 1 shows the results of the structural model. The results indicate that the impact of communication on JPS is significantly positive ($b = 0.51$; $p < 0.001$), providing support for H_1. Equally, the influence of JPS on SCRES is significantly positive ($b = 0.37$; $p < 0.001$); thus, H_2 is supported. There is a significantly positive moderating effect of Trust ($b = 0.12$; $p < 0.01$) on communication to JPS relationship; but digital transformation has significant negative moderating effect ($b = -0.08$; $p < 0.05$) on communication to JPS relationship. Therefore, while H_3 was supported, H_4 was not supported by our results. On the other hand, digital transformation significantly and positively moderates ($b = 0.07$; $p < 0.01$) the effect of JPS on SCRES, thereby providing support for H_5.

-- Insert Figure 1 about here --

Additionally, we also tested two separate models including the individual moderating effects of trust and digital transformation on JPS. In these models, the moderating effects were found to be insignificant. However, the collective moderating effect of trust and digital transformation (i.e., a model that includes both the interaction terms) on the relationship between communication and JPS relationship is found to be statistically significant (R^2-change = 0.009; $p < 0.01$). Additional analysis also suggests that JPS significantly mediates the effect of communication on SCRES (effect = 0.15; BootLLCI = 0.05; BootULCI = 0.27).

4.3. Additional analysis

Since our hypothesized model included two moderating variables (i.e., trust and digital transformation), we developed the confidence bands for the combined effects of both moderators on JPS; the confidence bands are presented in Figure 2. At a 95% confidence level, the combined effect of both moderators is found to be significant. The conditional effect of communication on JPS is significant at all levels of trust and digital transformation. The confidence bands also indicate that a high level of trust is conducive for communication to have a significant effect on JPS in the presence of at least some levels of digital transformation. An additional insight is that it is not essential to have high levels of digital transformation for communication to have a significant effect on JPS. In summary, we suggest that while both trust and digital transformation need to be present, the key is to find the right balance.

-- Insert Figure 2 about here --

We also determined the conditional effect of JPS on SCRES at different levels of digital transformation. The significance of these conditional effects was determined using the bootstrapping approach applying 5000 bootstrap replications (Preacher *et al*., 2007). The Johnson-Neyman technique was applied to determine the specific region of significance for the effect of JPS on SCRES (Hayes, 2018). Figure 3 presents the confidence band for the moderation effect of digital transformation. As evident from this figure, we find the positive effect of JPS on SCRES to increase with the increase in the level of digital transformation. Nevertheless, the conditional effect of JPS is significant only when digital transformation is above a threshold (starting when the digital transformation was above -3.0627); this is for the top 96% values of digital transformation.

-- Insert Figure 3 about here --

5. Discussion and conclusion

Our research intended to examine the role of JPS in developing SCRES capabilities. Given the significant improvements in operations and supply chain technologies, our study also tested the role that communication, trust, and digital transformation, together, play within the context of JPS and SCRES. The results of our analysis provide support for the effect of communication on JPS and the effect of JPS on SCRES. While trust and digital transformation was, together, found to positively moderate the effect of communication on JPS, digital transformation, by itself, was found to have an adverse effect in developing JPS. On the other hand, digital transformation was found to play a significantly important role when it comes to the relationship between JPS and SCRES. Now, we deliberate the theoretical as well as managerial implications of our results with the ambition of gaining a better understanding of how digital transformation could reshape JPS and the value that trust could still hold as an informal governance in BSR.

5.1. Theoretical Implications

Trust and relationalism often go hand in hand (Dyer and Chu, 2003; Nyaga *et al*., 2010). Although digital transformation has a negative moderating effect on the relationship between communication and JPS, we found trust to have a significant positive impact only in the presence of digital transformation (Poppo *et al*., 2016; Villena *et al*., 2019). We conjecture that these paradoxical findings provide some exciting insights into our understanding of BSR. First, communication for JPS is strongly dependent on tacit knowledge and firms' internal experience; to share those with partnering firms, the depth of relational value ('why' to share) is still more important than the method of communication ('how' to share). If supply chain partners trust each other and value their relationship, then communication can be meaningful even in the presence of little technological support. Second, applying new technologies in the supply chain or improving existing technology requires investment as well as relationship commitment (Power and Singh, 2007). Thus, supply chain partners having some sort of technological platform in BSR would be able to improve the level of trust. Third, improving connectivity through digital transformation in BSR might enhance information access and visibility (Hardgrave *et al.*, 2013), thereby resulting in trusting relationships.

Overall, our findings are in line with extant literature on strategic supplier relationships. When it comes to such strategic relationships, relational view purports that the role of trust is of paramount importance (Dyer and Singh, 1998; Dyer *et al.*, 2018). Accordingly, trust is an essential governance tool when it comes to engaging in JPS with key suppliers. The presence of complementary resources and collaborative idiosyncratic capabilities will not only drive informal governance like goodwill trust between the exchange partners, but also investments along with further collaborative efforts (Dyer *et al.*, 2018). In fact, strategic relationships tend to grow stronger if the partners also trust that there is value generation through joint efforts (Monczka *et al.*, 1998). However, trust is not everything; sometimes, other forms of governance tools may be required to support the effectiveness of trust (Mahapatra *et al.*, 2010). More importantly, simple technologies could also serve as key drivers of relational trust (Wasti and Wasti, 2008). In other words, as evident from our results, simple digital transformation that facilitate communication can improve trust and overall relational governance.

At the same time, heavy investment in technology could negatively impact relational trust (Nyaga *et al.*, 2010). Massive digital transformation could be overwhelming for supply chain partners. Theoretically, if complementary resources are replaceable, then value creation through BSR diminishes quickly (Dyer *et al*., 2018). Therefore, we can argue that higher digital transformation for the sake of communication and resource sharing within an untrusting relationship can make the partner worried about being replaced or removed; thus, they could be unwilling to participate in JPS. Second, often the application of new technologies in the supply chain is misunderstood and overrated (Kumar *et al*., 2020). Specifically, applying modern technologies in an existing supply chain can get highly complicated if the partners are not initially technologically competent (Karlsson *et al*., 2010). Hence, focusing too much on the adoption of new technologies without the consideration of other capabilities and BSR requirements can be damaging, rather than rewarding, for the relationship. Third, randomly applying every technological tool available can make the partners skeptical about the change; this can reduce relationship strength and weaken the level of trust. Fourth, in most cases, suppliers are not only smaller than the buying firms, but they also hold inconsistent capabilities or operation standards; so, the onus is on the buying firms to lead advancement across the supply chain (Joshi *et al.*, 2018). However, in such conditions, the suppliers might struggle to keep up with the new and advanced technologies that the buying firm introduces. If suppliers do not get the required support from the buyer firm along with digital transformation, then their performance as well as contribution in collaboration could both go down. Lastly, introducing digital transformation without strong trust and collaboration can easily facilitate all sorts of negative aspects of BSR. Opportunism, conflict and/or exploitation of internal knowledge are all common in an unbalanced and untrusting relationship that also includes poor governance (Bai *et al*., 2016; Chen and Lien, 2013; Lado *et al*., 2008). Therefore, digital transformation alone cannot improve communication for JPS; it might rather make it weaker. Accordingly, we conclude that to facilitate JPS in this age of digitalization, communication must be governed by trust (Im *et al*., 2019). Additionally, while simple technologies that improve communication can be supportive for relational value and trust, they certainly cannot be a replacement for relational governance. Finally, the use of technology for collaborative advantage has conflicting conclusions in literature (Narayanan *et al*., 2009); therefore, additional theoretical and empirical exploration is required to understand the reason for such an adverse effect of digital transformation.

The support for hypotheses 2 and 5 indicates that technological advancement has a strong influence on the effect of JPS on SCRES (Christidis and Devetsikiotis, 2016; Vanpoucke *et al*., 2014). Having a common technological platform could help firms to ensure standardization and compatibility in shared insights and resources. This could significantly simplify JPS for developing resilience capabilities like visibility, agility, and flexibility (Hardgrave *et al*., 2013). A technologically advanced supply chain could also provide better opportunities for the partners to work together after any disruption and to coordinate recovery planning based on JPS. Therefore, digital transformation can make BSR more effective to develop SCRES capabilities. We believe the reason for digital transformation working positively in this context, as opposed to the previous one, is because of the unique attributes of SCRES. When the partners in the supply chain experience hurdles in it, they become aware of their vulnerabilities and realize that if the supply chain fails to recover then it would be damaging for every partner. This could trigger a collective attitude and goal alignment in BSR. To prevent potential breakdowns, partners will show more interest in JPS capabilities for developing SCRES. Keeping physical closeness with partners is good for resource sharing focused on gaining resilience capabilities (Habermann *et al*., 2015). That same argument is applicable for having quick adaptation and strong connectivity to share experience and insight, because information processing and transforming speed could significantly improve SCRES (Bode and Macdonald, 2017). Consequently, digital transformation could play a positive role by enabling smooth and standardized resource sharing. In summary, to achieve competitive advantage through SCRES, BSR will require JPS, communication, trust, as well as a technology platform for resource and knowledge sharing; this conclusion is well aligned with the tenets of the relational view (Dyer *et al*., 2018).

Considering the paradoxical implications of our results, we forward a simple framework (Figure 4) to capture our post-hoc findings. As illustrated in this framework, with a bit of support from digital technology, BSR will gain from the presence of high levels of trust. In other words, lower digital transformation combined with higher levels of trust are where the relationship between communication and JPS could thrive. Alternatively, higher levels of digital transformation could be beneficial for SCRES. Additionally, higher levels of trust could also, indirectly, ensure that JPS has a stronger influence on SCRES (moderated mediation). Since digital transformation seems to play a differential role on the two sides of JPS, finding a proper balance in digital transformation will be extremely valuable for a supply chain. Conceptually, we conjecture that the overlapping region (i.e., medium levels of digital transformation and high levels of trust) could represent such a balanced position wherein JPS and SCRES capabilities could both thrive.

-- Insert Figure 4 about here --

5.2.Managerial implication

Our findings clarify that firm-level digital connectivity is not a replacement for building strong interpersonal relationships. Instead, with the advancements in supply chain technologies, firms should be more mindful of their informal governance tools and focus more on building a trust-based relationship. Practicing managers should understand that developing a trusting and long-term BSR with simple communication technology can strongly motivate partners to involve in JPS seriously. Similarly, our understanding is that the technologies that support relational capital (like ERP) could be much more helpful than technologies that are trying to replace relational values (like AI, blockchain). Partners will not mind sharing their insights for improving BSR capability if they trust each other. On the contrary, being connected through advance technologies on which the partnering firm might hold very little knowledge can reduce trust. In such cases, managers should be cognizant of the fact that the supplier might become overprotective of their internal resources. In other words, managers of the buying firm must not only ensure that suppliers are capable to support the planned digital transformation, but also try not to replace trust in their relationships through digital transformation. Our results also suggest that managers must invest in technologies that can enhance (1) supply chain visibility, (2) generate deep insight for every partner from shared data, (3) facilitate standardized preventive measures across the supply chain and reduce reaction time. In brief, relationship enhancing simple digital transformation like internal messaging or instant communication platform, or shared ERP dashboard with supply chain partners can improve JPS capabilities. Managers should invest in digital transformation when they can easily translate that into an investment for stronger BSR. Moreover, when it comes to digital transformation to enhance SCRES capabilities, there are significant benefits. Thus, managers should strongly consider digital transformations which can specifically help in disruption and risk mitigation.

5.3.Limitations

First, we have studied the hypothesized relationships from the buyers' perspective. Given that findings might be more substantive if data is collected from both buyer and suppliers' perspectives, we recommend future research to focus on dyadic data. Second, we had measured digital transformation collectively based on current emerging technologies. However, communication technologies and supply chain related Industry 4.0 technologies may have a contextual difference. Based on our findings of hypotheses H_4 and H_5, future research should consider communication and integration technologies separately. This way research personnel and practicing managers could better understand the impact of different types of digital transformation on JPS and SCRES. Third, this research was focused on manufacturing firms within developed countries. It will be interesting to study the impact that digital transformation can have on SCRES within an underdeveloped and/or developing economic context. Specifically, given that these economies are absorbing manufacturing technologies rapidly, studying those contexts can bring valuable insights into the SCRES capabilities of global supply chain networks. Fourth, the practice of SCRES and BSR within the service sector could be considerably different from our research context. Therefore, we believe that replicating our research in the service sector will make an invaluable contribution to literature. Finally, one of our key implications is that “why share” is a far more important question than “how to share” when it comes to facilitating JPS. This implies the significance of trust in BSRs as well as the supporting role of digital transformation. At the same time, we believe that it will be interesting to explore what sort of technologies would support not only the development of, but also the positive effects of trust the most. Additionally, future research could also explore whether there are different approaches to developing trust when it comes to different types of BSR.

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Table I: Measurement Instrument Development

Indicator	**Std. Loading**
(Coefficient Alpha, Coefficient Omega, Composite Reliability, Average Variance Extracted)	
Recovery capability *(α = 0.84; Ω = 0.85; CR = 0.85; AVE = 0.58)*	
When a disruption occurs, our firm immediately starts recovery efforts	0.77
Once a threat is identified, our firm deploys resources to reduce the negative effects	0.71
Our firm’s command centre deploys recovery resources to reduce the effects of a disruption	0.81
We restructure our resource base to react to the changing business environment	0.75
Flexibility *(α = 0.89; Ω = 0.89; CR = 0.89; AVE = 0.57)*	
We are flexible to adjust capacity and/or volume effectively within a short period	0.72
We are flexible to adjust deliveries to meet customer requirements	0.75
We are flexible to customise products to meet customer specifications	0.77
We are flexible to make design changes in the product after production has started	0.70
We are flexible in offering a large number of product features or options	0.78
We have high production flexibility to allow the efficient new product introduction	0.79
Visibility *(α = 0.86; Ω = 0.86; CR = 0.86; AVE = 0.76)*	
Inventory levels are visible through the supply chain	0.86
Demand levels are visible throughout the supply chain	0.88
Agility *(α = 0.87; Ω = 0.87; CR = 0.87; AVE = 0.57)*	
We work hard to promote the flow of information with our suppliers and customers	0.75
We work hard to develop collaborative relationships with suppliers	0.77
We design for postponement: Build inventory buffers by maintaining a stockpile of inexpensive but key components	0.70
We have a dependable logistics system or partner	0.79
We draw up contingency plans and develops crisis management teams	0.77
Digital transformation *(α = 0.91; Ω = 0.91; CR = 0.91; AVE = 0.64)* How well you are adopting these new technologies in your supply chain –	
Artificial Intelligence	0.74
Blockchain	0.77
Enterprise Resource Planning	0.71
Cloud-based ERP	0.83
e-Procurement	0.84
Cloud-based e-Procurement	0.89
Level of trust *(α = 0.90; Ω = 0.90; CR = 0.90; AVE = 0.60)*	
This supplier is always honest with us	0.79
We are confident in the information that this supplier provided us	0.78
This supplier is trustworthy	0.79
This supplier is genuinely concerned that our business succeeds	0.72
When making important decisions, this supplier considers our welfare as well as its own	0.78
We trust this supplier to keep our best interest in mind	0.79
JPS with this supplier *(α = 0.91; Ω = 0.91; CR = 0.91; AVE = 0.62)*	
We have joint teams for important/urgent tasks	0.76
We conduct joint planning to anticipate and resolve operational problems	0.82
We make joint decisions about ways to improve overall cost-efficiency	0.78
We have invested substantially in personnel dedicated to this relationship management	0.80
We have provided proprietary expertise and/or technology to this relationship for problem-solving	0.81
We have dedicated significant investments to this relationship for problem-solving	0.77
Extent of communication *(α = 0.83; Ω = 0.84; CR = 0.84; AVE = 0.47)*	
We share sensitive information (financial, production, design, research, and/or competition)	0.59
The supplier is provided with any information that might help them	0.75
Exchange of information takes place frequently, informally and/or in a timely manner	0.69
We keep each other informed about events or changes that may affect the other party	0.75
We have frequent face-to-face planning/communication	0.64
We exchange performance feedback	0.69

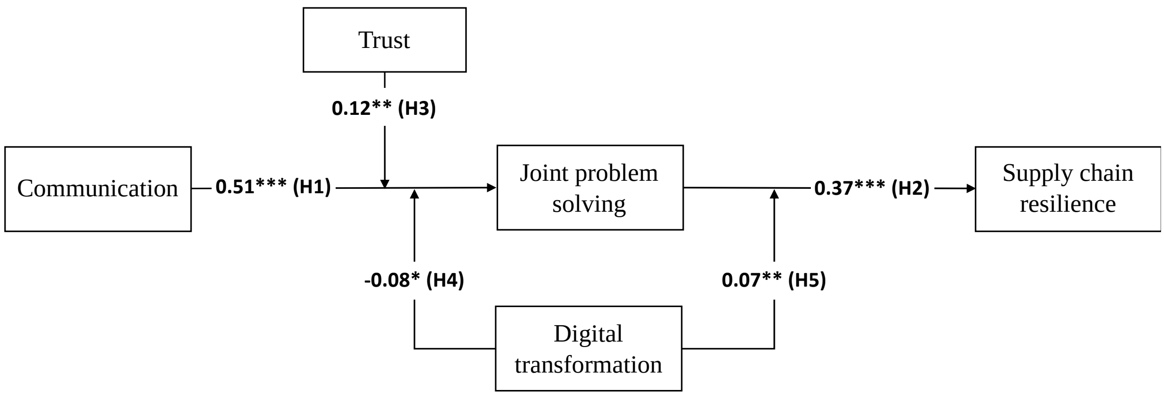
Model Fit Indices: Normed Chi-Square = 2.27 (≤ 2.0); Non-Normed Fit Index = 0.97 (≥ 0.90); Comparative Fit Index = 0.97 (≥ 0.90); Standardized Root Mean Square Residual = 0.06 (≤ 0.08); Root Mean Square Error of Approximation = 0.07 (≤ 0.08)

Table II: Correlation between Theoretical Constructs

Factors	Mean	SD	VB	AG	FX	RV	CM	JP	TR	DT
Visibility (VB)	5.4	1.2	**0.87**[a]							
Agility (AG)	5.5	1.0	0.63	**0.76**						
Flexibility (FX)	5.5	1.1	0.54	0.69	**0.75**					
Recovery (RV)	5.6	1.0	0.46	0.64	0.63	**0.76**				
Communication with key supplier (CM)	5.4	0.9	0.54	0.68	0.50	0.49	**0.69**			
Joint problem solving (JP)	5.3	1.1	0.50	0.59	0.44	0.40	0.67	**0.79**		
Level of trust (TR)	5.7	0.9	0.47	0.67	0.49	0.52	0.70	0.51	**0.78**	
Digital Transformation (DT)	4.6	1.4	0.44	0.51	0.43	0.41	0.49	0.56	0.38	**0.80**
Buyer's business size	6288	23915	0.10	0.11	0.05	0.01	0.14	0.14	0.07	0.15
Buyer's business age	36.21	28.47	-0.01	-0.03	-0.14	0.03	0.02	-0.05	0.01	-0.14
Age of relationship with key supplier	14.17	12.78	-0.02	0.03	-0.03	0.01	-0.03	-0.07	0.00	-0.09
Supplier importance	5.35	1.12	0.19	0.33	0.29	0.32	0.35	0.25	0.36	0.20
Suppliers' proximity	3.92	2.12	-0.03	-0.04	0.02	-0.07	-0.04	0.10	-0.08	0.08
Key supplier's relative size (%)	8.01	66.89	-0.03	-0.01	-0.05	-0.09	-0.04	-0.05	-0.06	-0.01
Investment specificity along with supplier	5.28	1.55	0.25	0.34	0.21	0.24	0.35	0.48	0.35	0.41

[a] The values along the diagonal are the square root of the AVE values.
Note: All correlation values were significant at $p < 0.05$

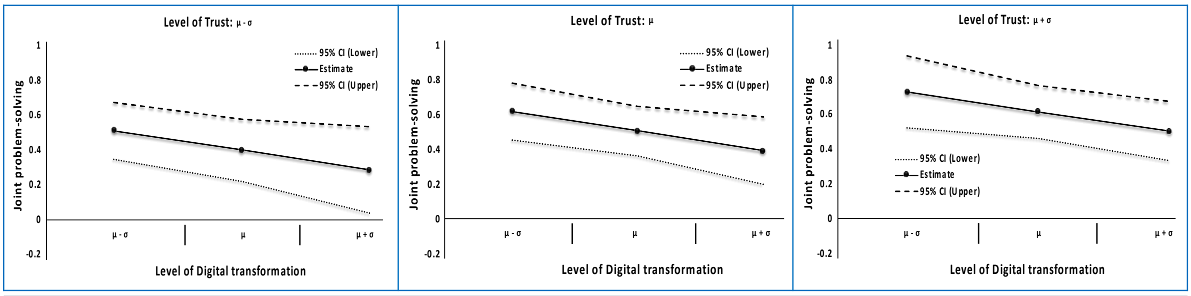
Figure-1: Structural model



***$p < 0.001$;**$p < 0.01$; *$p < 0.05$
Note: For JPS R2 = 0.57 and Model F = 34.13; for SCRES R2 = 0.45 and Model F = 17.48

Figure-2: Conditional indirect effect of communication on JPS
at different levels of trust and digital transformation

Panel - A



Panel - B

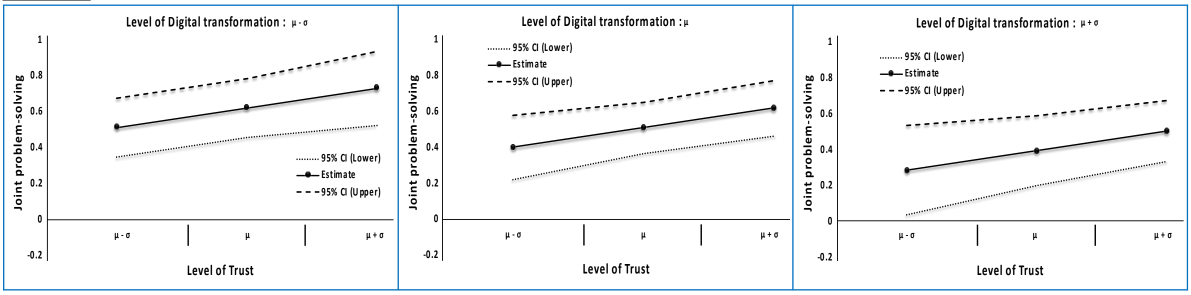


Figure 3: Conditional Effect of JPS on SCRES
at values of digital transformation

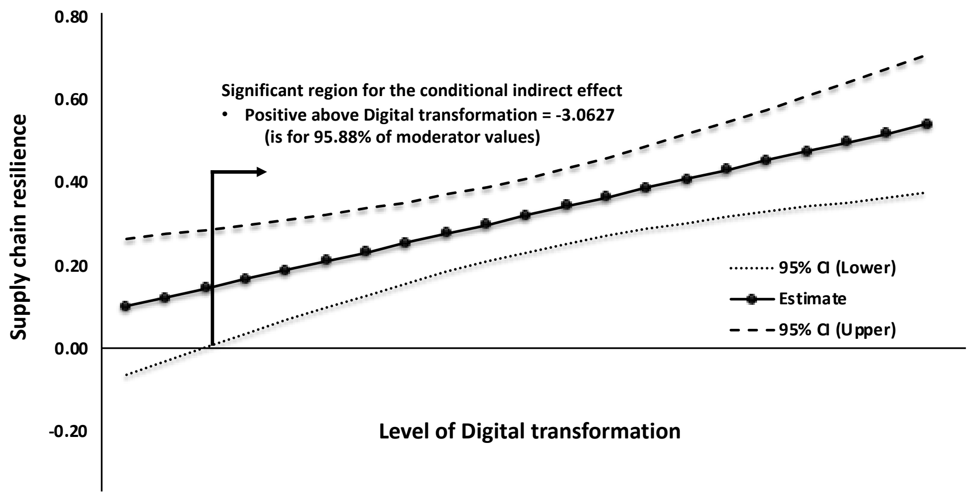


Figure 4: Framework to show paradoxical impact of trust and digital transformation