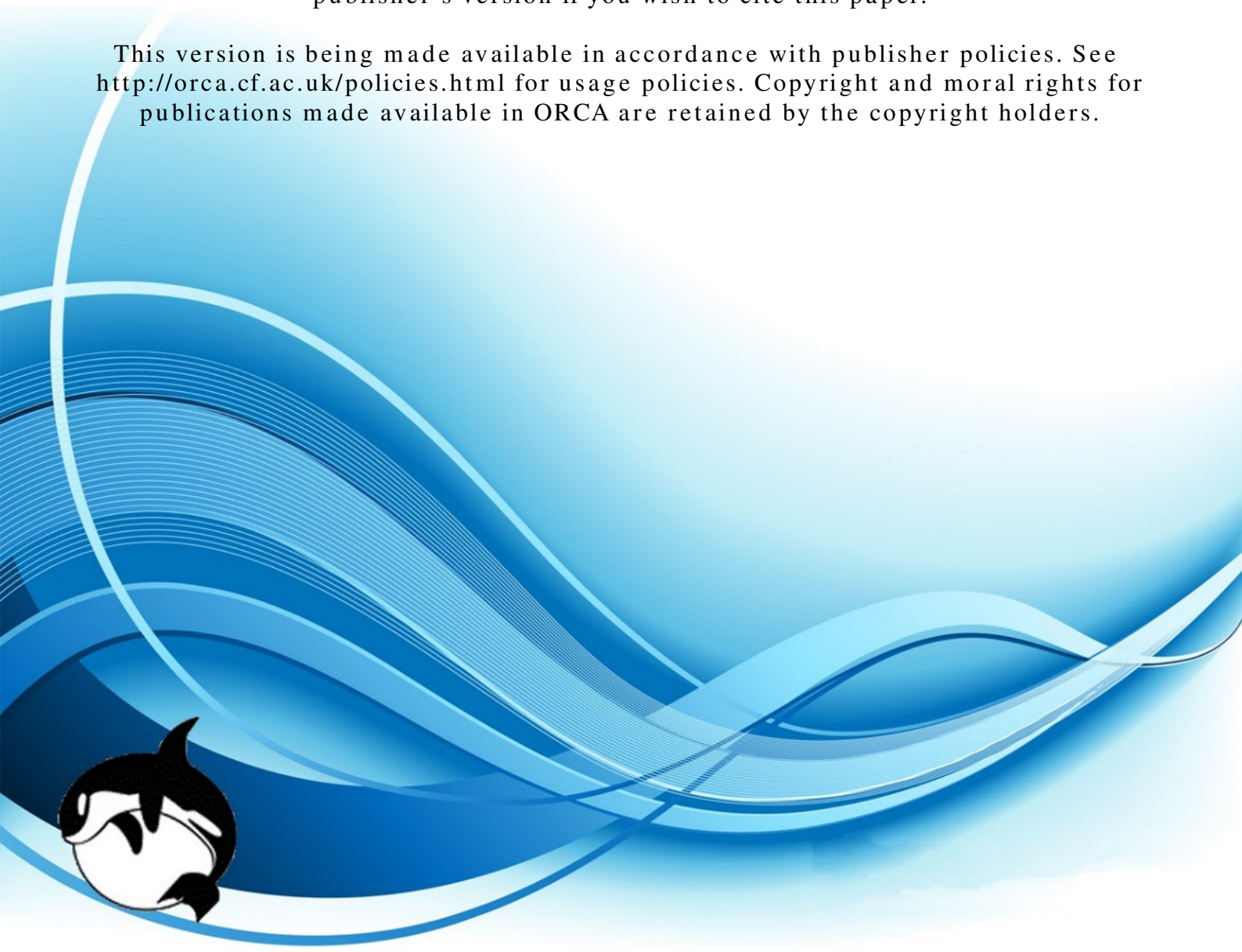

A meta-analytical review of antecedents and outcomes of firm resilience

Abstract

Despite the existence of a large body of literature on the topic of supply chain (SC) resilience, comprehensive empirical reviews of the antecedents and outcomes of resilience are limited. The purpose of this study is to develop a theoretical framework and carry out a meta-analysis of extant empirical studies to investigate the relationship between resilience, its antecedents and firm performance. The impact of three clusters of SC capabilities (organisational capability, SC flexibility, SC integration) on firm resilience (proactive, reactive or dynamic) is examined, and that of the impact of firm resilience on performance. We find that the overall impact of resilience on firm performance is strongly significant. However, in terms of financial performance, the correlation magnitude shows a weaker to moderate effect. In addition, for non-financial performance, the resilience impact is stronger. Furthermore, the analysis helps clarify some of the existing inconsistencies in the literature regarding the relationship between SC capabilities, firm resilience and performance by highlighting the moderating role played by resilience operationalisation, industry affiliation and national culture. The study contributes to theory on resilience and assists practitioners in developing resilient strategies for organisations and SCs.

Keywords: Supply chain capabilities, proactive resilience, reactive resilience, dynamic resilience, meta-analysis, systematic review.

A meta-analytical review of antecedents and outcomes of firm resilience

1. INTRODUCTION

Supply chain (SC) resilience is a prominent research area, reflecting the dynamic business environment in which firms currently operate. Firms are pressed not only to deliver products timely and efficiently while managing global and complex SCs, but also to design supply networks resilient to a variety of disruptions (Ali & Gurd, 2020; Ivanov & Dolgui, 2020; Zobel et al., 2020; Wong et al., 2020). During the COVID-19 pandemic, for example, global shortages of raw materials and components, combined with increased / decreased demand for certain products and panic buying events highlighted how fragile and vulnerable SCs are nowadays (Salvato et al., 2020; Ivanov, 2021a,b; Paul & Chowdhury, 2021; Ruel et al., 2021; Wieland & Durach, 2021). This confirms once more that firms need to rethink and re-evaluate their supply networks in order to be resilient. The adoption of resilient SC capabilities (SCCs) can enable firms to identify and reduce vulnerabilities before they occur, but also to react and recover rapidly and cost-effectively post-disturbance. Such ability to create resilient SCCs can lead to firms achieving growth and success (Birkie et al., 2017; Li et al., 2019; Chowdhury et al., 2019; Ivanov & Dolgui, 2020; Li et al., 2020; Queiroz et al., 2020; Aldrighetti et al., 2021).

The resilience literature is interdisciplinary but, despite a large body of theoretical and empirical work in fields such as psychology (Joyce et al., 2018; Oshio et al., 2018), economics (Lazzorani & van Bergeijk, 2014), business management (Linnenluecke, 2017; Bhamra et al., 2011) and supply chain management (Rice and Sheffi, 2005), its conceptualization remains fragmented. However,

some efforts have been previously made to examine the possible effects the adoption of SCCs can have on business resilience (Wieland and Wallenburg, 2013; Gölgeci and Ponomarov, 2015; Chowdhury and Quaddus, 2016; Riley et al., 2016). Despite these efforts, aspects such as to what extent different SCCs contribute to improving different business resilience levels remain largely unexplored or ambiguous. For instance, while Brusset and Teller (2017) argue that pursuing SC integration has a positive effect on resilience, Wieland and Wallenburg (2013) showed that it does not yield any significant increase either on reactive or proactive resilience. Similarly, Brandon-Jones et al. (2014) found a significant and positive effect of SC visibility on resilience, while Shao (2013) did not. Furthermore, researchers have also reported conflicting effects of resilience on firm performance outcomes (see, for example, Wieland and Wallenburg, 2012; Abeysekara et al, 2019). Moreover, the vast majority of resilience literature highlights a positive relationship between various SCCs and resilience outcomes (Ali et al., 2017, Hohenstein et al., 2015). However, the literature fails to address how SCCs relate to different resilience outcomes (Shin & Park, 2021). The literature also highlights that resilience impacts firm performance positively, but there is a paucity in explaining to what extent resilience impacts different aspects of performance, such as financial and non-financial outcomes. Additionally, despite the fact that supply networks have now become increasingly global and complex, most of the existing research pertains to a single region. This raises growing concerns related to the generalizability of research results (Revilla & Sàenz, 2014, 2017; Durach et al., 2017), as very few studies explore the underlying relationship between SCCs and resilience from a cross-country perspective (Park, 2011; Friday, 2018, Martinez, 2018).

Given these issues, a set of research questions emerge: What SC capabilities influence firms' resilience? Which of these capabilities contribute most to improving firm resilience? To what extent

does the adoption of resilience capabilities vary at different temporal phases of resilience (proactive, reactive and dynamic)? Do the underlying relationships vary across different national cultures and industries? How does resilience impact firm performance? How can previous inconsistent empirical findings on the relationship between SCC – resilience – firm performance be explained?

From this perspective, studies that previously focused on SCCs as important enablers or antecedents for resilience provide limited empirical validation (Stone and Rahimifard, 2018). At the same time, earlier systematic literature reviews conducted in the SC resilience domain are mainly qualitative in nature (Hohenstein et al., 2015; Tukamuhabwa et al., 2015; Ali et al., 2017; Lima et al., 2018; Ali and Golgeci, 2019; Hosseini et al., 2019). To the best of our knowledge, no earlier empirical meta- analytical review of the relationship between SCCs- resilience - firm performance has been conducted. Further, extant empirical studies report significant differences in the magnitude of correlation coefficients for resilience effects with its antecedent SCCs and firm performance. This possibly could occur due to the different constructs and conceptualizations employed and the multiple contexts investigated in previous studies. Moreover, a very limited number of studies have also examined the complex relationship between SCC – firm resilience – performance. Therefore, to assess the overall theoretical underpinning of this relationship, a meta-analytic investigation allows reconciling contradictory findings by using the effect sizes of sampled studies with weighted average techniques, as suggested by Hunter and Schmidt (2004). This methodology is a powerful quantitative tool that corrects the statistical artefacts present in previous studies and provides a better aggregate estimation. Furthermore, such quantitative reviews aid in recognising trends that are unobservable in individual studies (Glass, 1976). Therefore, it is expected that our study will

provide greater clarity in terms of current knowledge in the SC resilience field, thus contributing to extant theory and suggesting future research directions.

As such, to address the above issues, this study aims to answer the following research questions (RQs): (1) How do different SC capabilities affect firm resilience? (2) What is the impact of resilience on firm performance? (3) What is the influence of constructs operationalization (dynamic, proactive and reactive resilience) and contextual variables (national culture and industry affiliation) on the SC capabilities – resilience – firm performance relationships? A quantitative meta-analytic review of the antecedent SC capabilities for resilience and increased firm performance is conducted. The key findings are summarised in a new theoretical framework for resilience, along with moderating variables (construct operationalizations) and contextual factors.

In light of the above motivation, this study contributes to the extant SC resilience literature in multiple ways. First, we respond to the recent call of Stone and Rahimifard (2018) to have a comprehensive research model for SC resilience research. To the best of our knowledge, our study is the first to provide an integrated empirical synthesis of earlier studies on the antecedent SCCs for the resilience-performance relationship. From the literature review conducted, our study identifies three clusters of SCCs (i.e., flexibility, organizational capability and supply chain integration), grounded in the contingent resource-based view (CRBV) theory. Second, we also test the magnitude of the relationships between SCCs – resilience – firm performance in the sampled studies, hence providing some clarity towards previously inconsistent findings. Thirdly, the conceptual model proposed in this study contributes towards a broader understanding of previous SC resilience research by exploring the moderating effects of construct operationalization

(dynamic, proactive, and reactive resilience) and contextual factors (national culture and industry affiliation), thus advancing current theory. Finally, we also highlight that future research areas should consider the role of significant contingency factors affecting the relationship between SCCs – resilience - firm performance in order to further advance theory in the field of SC resilience.

In the following section, we focus on an overview of the theoretical underpinning of our study and hypotheses development. Next, we present the research methodology employed, where we describe the data collection process, coding and analysis. Later, we report our empirical results and lastly, we present a discussion of the results followed by theoretical and managerial implications, limitations and future research directions.

2. THEORETICAL FOUNDATIONS AND HYPOTHESES DEVELOPMENT

2.1 Theoretical Foundations

The Contingent Resource Based View

The SC resilience literature is grounded in the Resource Based View of the firm (RBV). Drawing on the work of Penrose (1959), the RBV states that a firm's competitive edge is influenced by the strategic resources or capabilities it possesses (Barney, 1991; Hoopes et al., 2003). The basic premise behind this view is that resources are heterogeneously spread across firms; if they are valuable, rare, not perfectly imitable and non-substitutable, they are able to sustain competitive advantage (Barney, 1991; Peteraf, 1993). This view has been used extensively by researchers to ground their studies exploring the relationship between SCCs and resilience outcomes (Brandon Jones et al., 2014; Mandal, 2017; Cheng & Lu, 2017; Dubey et al., 2018), as well as the relationships between such capabilities and firm performance (Liu & Lee, 2018; Mandal et al., 2017; Chowdhury

et al., 2019). The RBV has also been used to explore firms' approaches to reducing uncertainty to leverage SC resilience (Cheng & Lu, 2017; Ambulkar et al., 2015). Furthermore, at SC rather than firm level, by maintaining strong relationships among partnering companies, firms not only gain competitive advantage but are also able to reduce environmental uncertainty and create long-term stability (Bode et al., 2011). Thus, the adoption of the RBV perspective allows one to better consider how and when stakeholders build resilience in their SC. Nurturing internal and external integration in the SCs is complex, time consuming, expensive and requires unique capabilities (Chen et al., 2009; Barney, 2012; Giannoccaro & Iftikhar, 2020). Therefore, SC integration is viewed in the resilience literature as a strategic resource which could be utilized in alleviating SC disruptions and enhancing resilience (Wu et al., 2010). Consequently, by combining and utilizing resources across independent firms, new unique capabilities are formed (Grant, 1991; Sirmon et al., 2007; Lu et al., 2010). The development of these inter-organizational capabilities is often influenced by the environment in which firms operate; however, their presence and application may aid in explaining how firms gain competitive advantage over time (Wu et al., 2010). Furthermore, for a SC to achieve competitive advantage, its members must first develop internal organizational resources able to respond to adverse environmental events (Hendricks & Singhal, 2005; Bode et al., 2011; Cheng & Lu, 2017). Firms also develop flexible capabilities to respond to adverse circumstances by developing flexible and slack resources. From a RBV standpoint, flexibility is an essential capability (Worren et al., 2002), as it allows firms to respond to the evolving environment and stay ahead of the competition (Chahal et al., 2020).

Consistent with the RBV approach, our present study aims to evaluate the effects of the adoption of these strategic resources (flexibility, organizational capability and SC integration) on firm

resilience, which ultimately enables firms to better adapt to environmental changes (Hohenstein et al., 2015).

Despite the prominence of the RBV approach in SC resilience studies, some scholars have argued that it may be "context insensitive" (Ling-Yee, 2007). This implies that under the RBV, recognizing the circumstances or contexts in which resources or capabilities would enhance resilience could be difficult (Ling-Yee, 2007). In addressing this concern, the Contingency Theory (CT) states that to achieve cohesion at different organizational levels and be competitive, firms' policies and actions must acknowledge the specific context in which they operate (Ketokivi, 2006). It also suggests that firms must be adaptable to the market dynamics (Donaldson, 2001). Such a perspective is essential in addressing SC resilience for minimizing unforeseen disturbances (Grötsch et al., 2013).

In this vein, the Contingent RBV acknowledges that there are likely contingencies in the business environment that may affect the usefulness of different resources and capabilities for enhancing resilience (Aragon-Correa & Sharma, 2003). Different contingent factors have been identified in the extant literature, such as the geographical context (the national culture or the country's economic development status), company size, organizational structure (Mackelprang and Nair, 2010). Contingency RBV research can thus aid in further developing the resilience literature by providing a more nuanced understanding of the relationship between SCCs – firm performance (Sousa and Voss, 2008). This is a perspective that our study adopts, as further explained below.

Resilience in Supply Chains

Resilience is a multifaceted concept, and definitions of SC resilience in extant literature surround different conceptualizations. The *static* conceptualization of resilience particularly focuses on SCs' absorptive capacity to maintain their core operational functions after a disturbance occurs (Bhamra et al 2011). This is the ability to absorb or withstand the impact of a disruption and minimize its negative consequences, while the SC maintains its current form (Biringer et al., 2013). Conversely, the *dynamic* conceptualization emphasizes SCs' adaptive capacity, i.e. their ability to change themselves over time to persist in the disruptive environment (Carvalho et al., 2012; Giannoccaro & Iftikhar, 2020; Adobor, 2020). In line with Stone and Rahimifard (2018), the adaptive capacity is a subset of ecological resilience, where its concern is not to move to a pre-disruption stage but to transform/move to multiple other equilibria stages. However, ecological resilience also focuses on designing flexible, resistive systems and processes to start with, which could carry on functioning in the event of a disruption. Thus, Melnyk et al. (2014) argue that both the resistance capacity and the recovery capacity are critical components of resilience. Where resistance focuses on minimizing the disruption impact by avoiding it, recovery maintains the functionality by finding a return path after disturbance.

2.2 Hypothesis Development

The earlier sections have highlighted a significant gap in the literature in understanding the relationships between SCC – firm resilience and resilience – firm performance, as well as acknowledging the importance of numerous contextual factors that might impact these relationships. Various researchers use different definitions and operationalizations of constructs for SCCs, which we group under: organizational capability, SC flexibility and SC integration. This was informed by our study's grounding in the RBV of the firm, as well previous work by authors such

as Wu et al., 2010; Leuschner et al., 2013; Yu et al., 2015; Chahal et al., 2020). Table 6 provides a further overview as to how our categorization links to past studies. While previous definitions of the 3 main constructs used are very broad in the SC literature, Abreu-Ledon et al. (2018), Crook et al. (2008) and Nair (2006) argue that a meta-analytic study can be particularly helpful in order to analyze relationships involving broadly defined constructs. Such collective understanding of underpinning constructs will enable a meta-analytic study to contribute to theory building in the extant SC resilience field (Ataseven and Nair, 2017). As such, in our review we classify our constructs based on the definitions highlighted in Table 1 by following the 75% rule of thumb, based on Hunter and Schmidt (2004).

Organizational Capabilities

According to the RBV, organizational capabilities are the bundle of unique resources and capabilities that contribute to a firm's effort to attain a competitive edge (Corbett and Claridge, 2002). These organizational capabilities are firm specific and are a firm's strength (Wernerfelt, 1984), making it difficult for competitors to imitate, and are advantageous in coping with disruptions. Barney (1991) has viewed these tangible and intangible resources as valuable, rare, inimitable and non-substitutable (VRIN), therefore they can sustain a firm's position in the market during turbulent times (Chahal et al., 2020). According to Brandon-Jones et al. (2014) and Cheng & Lu (2017), resilience from an RBV perspective is an outcome of the organizational capabilities employed in order to minimize the unfavorable impact of disturbances. In the extant literature, previous empirical studies have established a positive association between a firm's operational and functional capabilities and resilience (Golgeci and Ponomarov, 2013, 2015; Chowdhury & Quaddus, 2016; Cheng & Lu, 2017; Durach et al., 2018; Kwak et al., 2018; Yang et al., 2018).

However, the existing literature identifies a broad range of different organizational capabilities that aid in enhancing resilience (see Table 6). These are comprehensive capabilities which are deemed to acquire, integrate, reorganize and prioritize resource allocation in a complex business environment (Teece, 2007). Quite often they also reflect organizational routines (Winters, 2000; Obstfeld, 2012), which focus on continuously performing activities in a response to a certain internal or external disturbance (Zollo and Winter, 2002). As a result, during any disruptive event, these organizational routines may play a significant role in reorganizing the distribution routine to deal with uncertainty (Chen et al., 2014). In addition, a firm's tangible and intangible unique resources help in improving its business goals and sharing its operations insights proactively to respond to market dynamics and minimize volatility (Vastag, 2000). Therefore, organizational capabilities may reduce the likelihood and / or impact of SC disruptions (Cheng & Lu, 2017), and lead towards a more resilient SC (Birkie et al., 2017). However, critics of RBV argue that owning valuable and rare resources do not necessarily lead to firms achieving their competitive goals (Hiit, 2011) – these resources need to be bundled into capabilities to create maximum value (Sirmon et al., 2008). Our study acknowledges this weakness. We treat "organizational capability" as a higher order construct and examine its impact on firm resilience. We hypothesize that:

H1: Organizational capability is positively related to firm resilience.

Flexibility

From a RBV perspective, flexibility is considered a key resilience capability (Worren et al., 2002), as it enables firms to respond to market dynamism and manage risks by reconfiguring their resources (Chan, 2003; Slack et al., 2009). Peck (2005) defines flexibility as "being able to bend

easily without breaking", where it ensures that changes brought by disruptive events would be absorbed through proactive responses (Juttner and Maklan, 2011). The extant literature highlights that firms employing flexible approaches also develop flexible manufacturing and order fulfilment processes, as well as a flexible supply base that they can call upon as and when needed (Tang and Tomlin, 2008; Zsidin and Wagner, 2010; Pettit et al., 2013). Flexibility oriented firms are more able to sense disruptions early, hence allowing them to design their course of action quickly and reconfigure their resources in response to the identified threats to gain competitive advantage (Sheffi and Rice, 2005; Lee and Rha, 2016). Flexibility is thus perceived as a proactive attribute for resilience (Naim et al., 2006).

The extant literature reports a significant and positive effect of SC flexibility on different resilience dimensions (proactive, reactive and dynamic) (Park, 2011; Shao, 2013; Brandon-Jones et al., 2014; Mandal et al., 2016; Lee and Rha, 2016). In the context of SC resilience, flexibility is described as the ability to quickly adapt and react to disruptions instead of withstanding the disturbance (Ponis and Koronis, 2012; Dolgui et al., 2018). Several studies on resilience have investigated the impact of these flexibility capabilities and found that they have a significant importance in developing an adequate response to a risk or disturbance (Christopher and Peck, 2004; Scholten et al., 2014; Shin & Park, 2021). Flexible approaches are usually adopted at a time of high uncertainty in supply and demand (Lee, 2002), as their innate characteristic is to respond quickly and cost effectively to disruptive changes in terms of volume and variety (Christopher, 2000; Wang et al., 2017). For instance, slack resources such as buffers of inventory or capacity are often consumed during a disruptive event. Therefore, these slack resources can alleviate the initial disruptive impact (Bode et al., 2011; Brandon-Jones et al., 2015).

At the same time, globalization has led to SCs becoming longer and more complex, increasing their vulnerability and the need for flexibility. Therefore, adopting practices such as certified secondary suppliers and alternative transportation modes allows the firm to restructure its supply network in response to an identified threat (Ambulkar et al., 2015). This suggests that firms need to adapt to the changing requirements of the environment they operate in, calling upon sources of flexibility from the SC, while adopting a transparent and visible SC to reduce information asymmetry and speed up the response to risk. Papers that study the relationship between flexibility and firm resilience can be found in Table 6. The above discussion leads to the following hypothesis:

H2: SC Flexibility is positively related to firm resilience.

Supply Chain Integration

Supply chain integration (SCI) is described as the extent to which firms strategically collaborate and cooperate with their network partners, as well as their internal departments or functions, to ensure a continuous flow of material, information, and finances at low cost and during adverse circumstances (Frohlich and Westbrook, 2001; Ataseven and Nair, 2017). SCI is considered a relational resource from an RBV perspective, making it valuable and inimitable, resulting in a competitive edge (Chen et al., 2009). According to Braunscheidel and Suresh (2009), SCI activities result in a more organized response to market disruptions and changes and are considered as an antecedent for disruption mitigation (Faisal et al., 2006; Li et al., 2019). Several studies have identified different dimensions of SCI which are relevant in the SC resilience domain (Wieland & Wallenburg, 2013; Shao, 2013; Chowdhury & Quaddus, 2016; Riley et al., 2016; Brusset & Teller,

2017; Liu & Lee, 2018; Li et al., 2019) (see Table 6). Furthermore, the SC literature discusses integration dimensions from two perspectives: internal integration (within an organization) and external integration (with suppliers and customers) (Schoenherr and Swink, 2012; Ataseven and Nair, 2017; Chahal et al., 2020).

Internal integration is referred to as collaboration, coordination and communication among the various functions within a firm, such as operations, logistics, procurement, sales & marketing, to achieve SC objectives (Schoenherr and Swink, 2012). Internal integration capabilities, across departments, are found to significantly influence a firm's resilience ability (Christopher and Peck, 2004; Jüttner and Maklan, 2011), as efficient intra-departmental integration creates visibility and reduces uncertainty, which leverages resilience capabilities (Ali et al., 2017). Furthermore, to minimize disruption risks, firms may organize skills development programs and technology development initiatives (Khan and Bernard, 2007) to continuously upskill their employees' expertise. In an integrated firm, employees may also leverage ERP technologies to detect anomalies and manage inventory levels to address potential operational disruptions (Riley et al., 2016). This internal integration orientation enables firms to circulate risk-related information across the organization, to reduce the disruption severity and likelihood of occurrence (Braunscheidel et al., 2010; Ali and Golgeci, 2019).

Firms, however, cannot work in isolation to avoid disruptive events and respond to market dynamics. Thus, they often call upon external integration mechanisms, emerging from maintaining collaborative relationships with upstream (suppliers) and downstream (customers) SC members. Customer integration, for example, aids in achieving strategic insights in order to develop optimal

solutions to changing customer needs (Schoenherr and Swink, 2012). Supplier integration, on the other hand, is described as designing integrative practices with key suppliers to ensure consistent supply from the supply base to meet external demand (Schoenherr and Swink, 2012). Papers exploring the relationship between SCI and firm resilience are presented in Table 6.

External integration competencies enable firms to develop collaborative networks and better manage disruptions. In this context, Beninger and Francis (2021) argue that cooperation between buyers and suppliers within SCs can enhance resilience (Wieland and Wallenburg, 2013), where enduring relationships in markets can act as a buffer (Viswanathan et al., 2010, Liu and Lee, 2018). These integrative competencies also assure a sustainable competitive advantage (Ponomarov and Holocomb, 2009). However, the strength of the impact of the external integration on resilience can depend on factors such as disruption severity or SC complexity. Recently, Giannoccaro and Iftikhar (2020) posit that the beneficial effect of expected collaboration with network partners on resilience would be higher when the environment is stable and less disruptive. Similarly, Dyer and Singh (1998) suggested that relational governance would become difficult when there will be high structural complexity and hence would adversely affect resilience (Chowdhury et al., 2019; Craighead et al., 2007). However, Fynes et al. (2004, 2005) argue that relational competencies in SCs may lead to firms struggling to offset operational disruptions, hence displaying reduced resilience. This calls for an in-depth investigation of the relationship between integration and firm resilience. In line with the above discussion, the following hypothesis is proposed:

H3: Supply chain integration, in terms of (a) internal integration and (b) external integration is positively related to the firm resilience.

TABLE 1

Constructs Operationalization

----------Insert Table 1 Approximately Here----------

2.3.Resilience and firm performance

Recent literature reviews and empirical studies in the SC resilience domain highlighted that there is a growing interest in examining the role of resilience in the performance of firms (Abeysekara et al., 2019; Ali and Golgeci, 2019; Yu et al., 2019). From the RBV perspective, SC resilience enables firms to integrate and transform internal and external resources, respond to the changes brought by various disruptions and thereby achieve a higher operational performance while maintaining efficiency in the value creation process (Birkie et al., 2017). Other researchers argue that investment in being resilient is a trade-off with the total cost (Juttner et al., 2003) (financial performance), and when not adequately managed and/or when the response to disruptions is slow, this can lead to reduced overall firm performance (Li et al., 2017). Considering the conflicting impact resilience can have on performance outcomes, there is a need to further explore this relationship.

In our study, firm performance is categorized as financial and non-financial performance to capture the complexities highlighted above. Some studies that examine the impact of resilience on financial performance are: Yu et al. (2019); Golgeci and Kuivalainen (2019); Wieland and Wallenburg (2012); Abeysekara et al. (2019); Li et al. (2017; 2019); Martinez, 2018). Further studies that also explore the resilience impact on non-financial performance are: Wieland and Wallenburg (2013); Riley et al. (2016); Lee and Rha (2016); Chowdhury and Quaddus (2016); Kwak et al. (2018); Liu and Lee (2018). Some studies also report that those firms that struggle to maintain business stability

during a disruption appear to incur financial costs in terms of backorders, sales loss, reduced market share, diminished revenue, and shareholder value (Hendricks and Singhal, 2005; Golgeci and Kuivalainen, 2019). However, non-financial costs are also incurred in terms of idle resources, reputation damage, late deliveries, poor customer service, reduced quality (Kleindorfer and Saad, 2005; Hohenstein et al., 2015). In this context, when struck by disruptions, firms that are more prepared to, for example, deploy slack resources such as spare inventory may experience less negative disruption amplification (Hendricks et al., 2009), thus evidencing higher non-financial performance. Both dimensions, financial and non-financial, thereby affect the overall firm performance and should be investigated when studying resilience. Therefore, we propose the following hypothesis:

H4: Firm resilience is positively associated with firm performance based on (a) financial and (b) non-financial dimensions.

2.4.Moderators of the Relationships between SCC – FR and FR – Firm performance

Quantitative meta-analysis techniques allow researchers to explain the heterogeneity in the effect size of the studied relationships by examining key measurement characteristics (Hunter and Schmidt, 1990; Abreu-Ledon, 2018). As sampled studies for meta-analyses are conducted in different populations with various firm sizes and in multiple sectors, the nature of the underlying relationships may vary. Thus, studying a variety of possible moderators can enable a better understanding of possible differences in results. We adopt this perspective in our meta-analytic study of the relationships between SCC – FR and FR – firm performance. This is also consistent with the Contingent RBV theoretical lens we introduced earlier (Lawrence and Lorsch, 1967),

which further emphasizes the fact that different contextual situations can explain variations in organizational success. To be noted here is that the impact of a particular moderator is determined by creating different subgroups to compare its individual effect against the main effect (Leuschner et al., 2013).

We thus also aim to investigate in our study how various construct operationalizations and contextual variables affect the relationship between antecedent SCC – FR and FR – firm performance. Consistent with previous studies, we identified three moderating variables (resilience operationalization, national culture and industry affiliation) for the relationships on which our study focuses on. Mackelprang and Nair (2010) points out that the term "moderator" is more commonly used in meta-analyses, while the term 'control variable' in more commonly used in primary empirical studies.

Additionally, extant literature has examined the impact of SCC on FR without particularly exploring the specific resilience stage they are applied at (pre- or post-disturbance). This is in stark contrast with current resilience theory, which argues that it is essential for firms to understand which specific SCCs have a stronger effect on resilience before, during, as well as after disruptions (Ponomarov et al., 2009; Ali et al., 2017). Thus, it is important to explore *when* specific SCCs are more useful when dealing with SC disruptions. This will help the decision maker to reorganize and allocate their resources accordingly, to better deal with disruptions, and could serve as explicit guidelines. In the following, we explain how these differences in resilience operationalization (proactive, reactive and dynamic resilience) could affect the SCC – FR relationship and we propose new hypotheses.

2.4.1Resilience Operationalisation

Proactive Resilience

Proactive resilience refers to SCs' ability to adopt ex-ante measures (*before* the disruptive event) and remain stable during times of change (Durach et al., 2015). It includes the dimensions of *alertness, readiness* and *preparedness* for disruption (Conz and Magnani, 2020). This suggests that to thrive at the time of disruptions firms must take proactive steps so they may continue operations while resisting the impact. In a world where firms are affected by a wide range of disruptions, from internal operators errors to external natural disasters, SCs and operations managers need to have a pre-emptive attitude for readiness, preparation and recovery (Christopher and Peck, 2004; Pettit et al., 2010). SCs which are inclined towards readiness display flexible capabilities and strategies to reduce vulnerabilities (Ponomarov and Holocomb, 2009; Pettit et al., 2013). Also, Hollnagel et al. (2006) argue that the pre-emptive capability of a resilient system, before the occurrence of adverse consequences, is to monitor the environment, anticipate the threat and resist the change, hence better prepare themselves for inevitable disruptions (Pettit et al., 2010).

Reactive Resilience

This conceptualization of reactive resilience refers to SCs' ability to respond to disturbances while returning to the original equilibrium or reconfigure its structure and achieve a new equilibrium *after* the disruptive event takes place (Bhamra et al., 2011). Thus, reactive resilience concerns the post-disturbance phase and involves the ability to *respond*, *survive*, *return* or *bounce back* (Conz and Magnani, 2020). Thus, SCs which respond and recover rapidly from a disruptive event are often perceived as being more resilient (Sheffi and Rice, 2005). A late response to different disruptions is likely to incur severe losses (Norman and Jansson, 2004; Pettit et al., 2013).

Dynamic Resilience

A further relevant aspect related to resilience is the fact that previous conceptualizations of resilience refer to the set of dynamic adaptive responses alongside the various resilience phases, such as: anticipating, preparing, responding, recovering, and maintaining. Therefore, numerous authors argue that SC resilience must combine the proactive behavior associated with developing pre-planned steps to respond to disruptive events (proactive resilience), as well as responsive steps post-disturbance (reactive resilience). The idea is to not only maintain an equilibrium position but to develop a continuously adaptive approach to tackle complexities in intertwined SCs (Carvalho et al., 2012; Hohenstein et al., 2015). During the recent global pandemic (COVID-19), we saw that we are living in a chaotic and uncertain environment. This further emphasizes the significance of the concept of dynamic resilience, focused on developing an adaptive response capability at short notice. This implies that firms must consider resilience as a situational capability gained by learning & development and continuous adaptation to multiple disruptions (Belhadi et al., 2020).

This perspective is consistent with previous definitions of resilience which highlight that *both* pro-active and re-active elements are required to deal with an unexpected event, hence the need for a dynamic resilience view. For example, Ponomarov and Holcomb (2009) define SC resilience as "the adaptive capability of the SC to prepare for unexpected events, respond to disruptions *and* recover by maintaining continuity of operations at the desired level of connectedness and control over structure and function".

Furthermore, our review of the literature indicates that while extant theory has identified a large number of capabilities required to achieve SC resilience, it failed to capture the relevance of these capabilities at different resilience phases (pre-and post-disturbance), which are now reflected in SC resilience definitions (Scholten et al., 2019; Ali et al., 2017). Previous researchers thus assumed that antecedent SCCs for resilience have equal relevance before, during, and after the disruption occurs. However, more recently, Conz and Magnani (2020) argue that firms may require different capabilities at different resilience stages. These differential effects of SCCs on each temporal phase of resilience have not been previously synthesized, and this issue deserves further investigation. In line with the above discussion, we hypothesise that at different temporal phases of resilience, the relationship between SCCs and firm resilience will differ.

H5: The effect size between (i) organizational capability, (ii) SC flexibility, (iii) supply chain integration, and firm resilience vary at different temporal phases of resilience.

Furthermore, our literature review above has highlighted that the relationship between SCC, as an independent variable, and resilience, as a dependent variable, is complex. One of the reasons is that there is a vast range of capabilities acknowledged, but also that their implementation varies in different contexts. SCCs applied in a population of different countries/regions and sectors, for example, can yield dramatically different results (Chang et al. 2016). As a result, we propose two further contextual variables for our study.

2.4.2.Industry affiliation

The industry in which organizations operate is considered an important moderating variable, with many SCM studies testing its effectiveness. Every industrial sector is acknowledged to possess

different dynamics, which might impact the adoption of organization capability, SC flexibility and SC integration capabilities to enhance resilience. A large number of extant studies in the resilience domain focus on manufacturing sectors (Wieland and Wallenburg, 2013; Golgeci and Ponomarov, 2013; Brandon-Jones et al., 2014; Chowdhury and Quaddus, 2016; Cheng and Lu, 2017). However, other studies collected data from various industries, including services, such as healthcare, oil & gas, transport, tourism, utilities etc., (Riley et al., 2016; Shqairat and Balan, 2018; Yang and Hsu, 2018; Liu et al., 2018; Parker and Ameen, 2018). The SCM literature, however, acknowledges that different industries have different SC characteristics, such as the level of structural complexity they display (Serdarasan, 2013). For example, automotive and electronics SCs are characterized by a high number and variety of product sub-component and parts, with multiple tiers of suppliers in the network, which are also affected by high levels of demand uncertainties (Turner and Williams, 2005; Handfield, 2004). Similarly, the humanitarian SCs possess complex geographical characteristics, bureaucratic issues with governmental and non-governmental agencies, difficulties in mobilizing logistical assets, among others (Oloruntuba, 2007). These different SC characteristics and structures are likely to impact the resources and capabilities required to manage complexity, adverse circumstances and enhance resilience levels. Researchers have drawn samples from various industries as compared to the specific manufacturing sector. Thus, we hypothesize that the adoption of SCCs for resilience (organizational capability, SC flexibility and SC integration capability) may differ across industries.

H6: The relationship between (i) organizational capability, (ii) SC flexibility, (iii) supply chain integration and firm resilience varies across industries, with a weaker effect size in the manufacturing industry.

2.4.3.National Culture

There is a paucity of research in distinguishing how Western and Eastern cultural differences affect firm resilience (Revilla and Sáenz, 2014). This is despite the fact that extant literature supports that such differences exist, as argued by Hofstede (2001), who contends that the adoption of management practices varies across national cultures, based on the values, norms, and belief systems that societies hold. Naor et al. (2010) also reported statistically different effects of Western and Eastern countries on operations management performance. One of the distinctive factors of culture for different societies, in terms of their interaction with the managerial practice, is how well they deal with risk, uncertainty and unpredictable situations (Hofstede, 2001; Taras et al., 2012), hence the importance of further investigating this factor when examining resilience (Durach et al., 2017).

Various cultures can exhibit stark differences in the managerial practices adopted, regulatory forces, relational governance employed (Jia and Zsidin, 2014; Kraude et al., 2018), which could impact the resilience outcomes of a firm. Further, the cultural specificity of a country could also influence the operational practices of individual firms, as well as employee perceptions and firms' response to threats, and this can result in higher susceptibility to vulnerabilities (Tukamuhabwa et al., 2015). Kraude et al. (2018), for example, highlight that countries in Eastern cultures have a higher degree of perceived SC risk but report considerably lower adoption of risk mitigation strategies as compared to countries from Western cultures. Further studies have also shown that the degree to which firms from different cultures employ various operational capabilities, flexibility approaches and SCI methods for risk reduction varies greatly (Jia and Rutherford, 2010; Durach et al., 2017; Kraude et al., 2018). This leads us to hypothesize that:

H7: The relationship between (i) organizational capability, (ii) SC flexibility, (iii) supply chain integration and firm resilience varies between Western and Eastern cultures, with a greater effect size in the Western cultures than the Eastern cultures.

FIGURE 1

Research Framework

----------Insert Figure 1 Approximately Here----------

3. RESEARCH METHODOLOGY

3.1.Systematic literature review

Our purpose in this systematic literature review (SLR) is to identify and examine all empirical studies investigating the correlation between SCC, FR, and FP. SLRs are distinct from "traditional" reviews as they follow a rigorous and systematic approach for identifying and evaluating studies (Denyer and Tranfield, 2009). For extracting the results, we followed PRISMA guidelines and searched specific keywords between 2000 and 2019 in three databases: Scopus, Web of Science, and Ebsco Host (Business Source Premier). We also searched for conference proceedings from the above databases, as well as Open Access Thesis, Dissertation databases, and the Research Gate research forum to identify unpublished studies. Since the first paper related to the SC resilience area was published in the year 2000 (Svensson, 2000), no earlier year was considered as a starting point (Ali et al., 2017).

In line with other SLR on SC resilience (Hohenstein et al., 2015; Ali et al., 2017) the defined keywords and search strings were combined using Boolean connectors and searched in the title,

abstract, and full text of studies published in peer-reviewed journals. We used different possible synonyms for resilience, to ensure no relevant paper gets missed: "Supply chain" OR "supply network" AND “resilien*” OR “security” OR “vulnerability” OR “mitigation” OR "business continuity". To satisfy the requirements of meta-analysis, papers considered must possess quantitative data with Pearson’s correlation coefficients, or its variants, of the relationship between SCC-FR and FR-FP. Our search resulted in a total of 5970 studies; after removing 1474 duplicated papers, 4496 papers remained. These papers were screened using the following inclusion criteria:

i- The Year of publication must be between 2000 and 2019.

ii- The main focus of the paper must be SC resilience. For instance, papers without a clear focus on SC disruption management or/and resilience, were not included.

iii- Only English language literature was included.

iv- Studies must have examined the relationship between any SC capability and at least one measure of FR or/and FP.

v- The sampled studies’ dependent and independent variables must be in coherence with the relationship of SCC – FR or/and FR – FP linkages.

vi- Studies with qualitative (case studies, interviews, Delphi study, conceptual papers) and simulation methodologies were not included.

vii- Studies must possess quantitative data like sample size with Pearson’s correlation coefficients, or its variants so that the correlation could be calculated separately.

viii- Studies whose full text and missing statistics were not available (even upon contacting the original authors) were not included.

Further, to avoid the problem of duplication effects in our meta-analysis, we ensured that the studies were independent, with no overlapping samples present. Therefore, we used the detection heuristics as suggested by Wood (2008) to examine four sets of studies with overlapping samples. From these, two studies with duplicate datasets were coded separately, as their constructs were significantly different. However, the remaining two studies (PhD dissertations), were marked as duplicate, as the resulting published peer-reviewed papers used similar data, constructs and measures. We also examined the reference list of the recently published literature reviews to assure no relevant study is missed out.

To be more inclusive in our meta-analysis, we included all journals. This practice is adopted to avoid inconsistencies in associating journal quality with article quality (Leuschner et al., 2014). Further, the inclusion of dissertations and conference proceedings also helps eliminate publication bias (file drawer bias) (Rabinovich and Cheon, 2011). The publication bias was further checked (see subsequent section) to ensure the meta-analysis has a significant sample representation of the SC resilience literature (Borenstein et al., 2009). For those papers which reported missing data, emails were sent to the authors. As such, in total, we include 56 studies (47 peer reviewed articles, 8 dissertations, and 1 conference proceeding) for the final review process. Among these, 19 studies examined the effects of both the antecedent SCCs for resilience as well as their further effect on firm performance. Therefore, we divided the datasets into two subsets: first, we reported antecedent SCCs - FR correlations from 48 independent samples (k) comprising 17,682 organizations as sample size (N); a second dataset focused on the relationship of resilience - firm performance, with correlations obtained from 27 independent samples (k) comprising 8,473 organizations as the sample size (N). Collectively, this meta-analysis encompasses 26,155 organizations. The sample

size of this meta-analysis (56 studies) is consistent with other meta-analyses in the OM domain (Mackelprang and Nair, 2010; Zhang et al., 2020; Manhart et al., 2020; Wenke et al., 2021).

Coding strategy

The 56 studies identified were coded based on a protocol to record construct operationalization, sample size, data collection country, empirical statistics, and other relevant indicators. This coding process resulted in identifying different SCCs, namely organizational capability, flexibility and SC integration, and along with different temporal phases of resilience (dynamic, proactive, and reactive) and distinct dimensions of firm performance (financial and non-financial). Table 1 summarises the construct definitions used in this meta-analysis. To ensure consistency among construct boundaries, when faced with difficulty for distinguishing construct operationalization, disagreements were resolved through discussions between authors (Hunter and Schmidt, 2004). Two authors were involved in the coding process for this meta-analysis and confirmed construct operationalization when 75% of the items matched the agreed definition (Hunter and Schmidt, 2004; Wang et al., 2018). To ensure consistency among the constructs, we focused on how they are measured instead of how they are labeled, ensuring that the scale items of each construct are consistent with their respective label. In case of a discrepancy issue during coding, we also referred to the relevant literature and reached a consensus through discussion. Consequently, the 56 studies were coded using the three SCCs: organizational capability (24 studies), flexibility (23 studies), SC integration (29 studies), as well as firm performance (27 studies). A detailed description of the construct measures is given in Table 6.

The studies selected were found to have used the construct *FR* for the first dataset, as a dependent variable, with multiple measurements. The coded FR definitions are conceptualized in terms of *proactive resilience* (representing any of these phases in the construct definition: *anticipation, warning, readiness, preparedness, resistance*) and *reactive resilience* (representing the *quick response, recovery,* and *restore phases*). To be more specific, 16 studies explore proactive FR and 32 studies explore reactive FR. However, the remaining 12 studies explore FR from the dynamic resilience perspective, discussing the before, during, and after disruption phase in a single construct. Table 1 captures definitions for these resilience phases. The conceptual definitions of FR were transcribed into Excel and coded into different resilient indicators.

For the second dataset, FR was used as an aggregate independent variable for FP, with multiple measurements. The firm performance in the sampled studies was categorized into financial and non-financial performance, based on the constructs used. In total, 7 studies report financial performance, while 22 studies report non – financial performance, mainly focusing on operational performance and competitive advantage. Please see Table 1 for firm performance construct definitions.

To conduct the moderator analysis, we used the construct operationalization of resilience (proactive, reactive and dynamic resilience) and two categorical variables (national culture and industry affiliation). For the resilience operationalization, we conducted sub-group analysis of different resilience phases. We present the results with their respective SCCs and FR relationships. However, to code the 56 studies for national culture, we use the approach from Naor et al. (2010) and Jadil et al. (2021) and divide the sampled studies into two subgroups: Western and Eastern culture. This is based on the view that the 2 groups of cultures hold significant differences in their

behaviors, norms and values, thus impacting the adoption of capabilities for resilience (Durach et al., 2017; Kraude et al., 2017; Revilla and Saenz, 2014). Countries grouped into the Western culture group are United States, Germany, Austria, Switzerland, UK, South Africa, etc., and in Eastern culture are China, Bangladesh, India, Iran, South Korea, Taiwan, Turkey, Morocco, etc.. The grouping is based on the GLOBE model. Studies collecting data from both Eastern and Western countries (Friday, 2018; Park, 2011) were not included in the moderator analysis, to avoid any bias. For the second moderator, industry affiliation, we sub-grouped sampled studies based on two groups: manufacturing (studies collected data solely from the manufacturing sector) vs various industries (studies collected data from different sectors). During the subgroup analysis, we also performed Q-test homogeneity analysis on the categorical moderators to examine the extent to which they are homogenous or heterogeneous in their underlying relationships.

3.2.The Meta-analytic process

We computed the corrected weighted mean effect sizes for the antecedent SCCs – FR relationship and for the FR – firm performance relationship. To obtain these effect size estimates, we conducted a psychometric meta-analysis methodology, as suggested by Hunter and Schmidt (2004). The basic purpose is to get an insight into a phenomenon by analyzing the effect size of the independent variables on the dependent ones. Due to the lack of consensus and even contradictory findings in extant empirical studies on the understudied phenomena, consolidation of knowledge is seen as essential for scientific inquiry. Rosenbusch et al. (2011) and Hunter and Schmidt (2004), for example, argue that these controversial findings can occur due to differences in the sampling criteria and thus lack generalizability. Therefore, a meta-analysis is considered essential in consolidating

past empirical findings to generate new theory (Raudenbush et al., 1991) by using information such as sample size and reliability estimates to validate conclusions (Mackelprang and Nair, 2010).

As an initial step, we examine the mean effect size between SCC – FR and FR – FP, reported by each study. For those studies where Pearson correlation was not reported, the t – stats were converted using $r = \sqrt{t^2/(t^2+df)}$ (Hunter and Schmidt, 2004). Further, where multiple correlations for a single measurement were reported, the composite correlation was computed to avoid inflation of results (Hunter and Schmidt, 2004). Further, to correct the correlation for attenuation, we used the reliabilities (Cronbach's alpha) of each measurement. The average of the reliability values of each dimension of SCC and FR was used. If the Cronbach's alpha value was not given, we used the composite reliability. When neither of these indicators was reported, we used the conservative value 0.7 (Hunter and Schmidt, 2004). The attenuation factor was calculated as $A=\sqrt{\alpha_{xx}} \times \sqrt{\alpha_{yy}}$, where α_{xx} represents the Cronbach's alpha of the independent variable and α_{yy} that of the dependent one. Further, corrected correlations (r') were calculated r'=r/A (Hunter and Schmidt, 2004).

After calculating the individual effect sizes, we also calculated the total corrected weighted mean effect sizes. Subsequently, we calculated the 95% confidence interval (CI) and the Q-statistics to assess the existence of moderators (Hunter and Schmidt, 2004; Golicic and Smith, 2013). CI confirms the significance of the mean effect size, based on the presence or absence of zero in the CI. I^2 statistic was also reported to assess the proportion of total variation in the effect sizes across the sampled studies. Therefore, a higher I^2 value represents higher heterogeneity. This strengthens the case of this meta-analytic study for the moderator analysis (sub-group analysis). Further, if there is high heterogeneity in the sample based on significant Q and I^2 statistics, a random effect model is suggested (Borenstein et al., 2010). In this study, the heterogeneity results of SCC – FR and FR

– firm performance relationships represent more than 75% I^2 statistics, this confirms high heterogeneity in our sample. Therefore, we applied the random-effects model. We employed the Comprehensive Meta-Analysis V3 software to conduct this analysis.

Finally, to assess the robustness of the results, publication bias calculations were performed. This represents a 'file drawer problem' in meta-analysis and can occur when studies with non-significant or smaller effect sizes are not selected in the meta-analysis, which results in a sample selection bias. However, as explained in an earlier section, we also selected unpublished studies (dissertations and conference proceedings) in this meta-analysis. Therefore, we calculated fail-safe N and performed Egger's linear regression test (Rosenthal, 1979; Egger et al., 1997). Referring to Table 2 for the publication bias test, concerning each relationship of SCC – FR and FR – firm performance, we report the publication bias test. Fail-safe N values represent the number of additional studies required to nullify the findings. The calculated Egger's regression intercept's significance value is greater than 0.05 in every specified relationship, thus indicating that no bias can be identified.

TABLE 2

Results for Publication Bias

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4. FINDINGS AND ANALYSIS

4.1.Results of the meta-analysis

We analyzed the data available for each hypothesized relationship and present the following results: the number of sample studies (k), the total sample size (N), corrected weighted mean effect size

(r_c), 95 percent confidence interval, and the homogeneity statistics. We first tested the main effects of antecedent SCCs on resilience and resilience on firm performance. Later, we also checked for the moderating effects (sub-group analysis) of resilience conceptualization on the SCC – firm resilience relationship using two categorical moderators (national culture and industry affiliation).

Main effect analysis

The results of antecedent SCC and firm resilience relationships are conducted in three separate groups, as illustrated in Table 3a (Organizational Capability – FR), Table 3b (SC flexibility – FR), Table 3c (SC Integration – FR), and Table 4 (Firm Resilience – Firm Performance). In the relationship of Organizational Capability and FR (Hypothesis 1), the corrected weighted mean effect size is 0,481 (See Table 3a). The 95% confidence interval ranges from 0,388 to 0,565 with (Z=8.90 and p=0.00), which shows a significant and positive relationship between organizational capability with overall firm resilience. Accordingly, for Hypothesis 2 (SC Flexibility), the corrected weighted mean effect size is 0,455, with 95% CI ranges from 0,353 to 0,546 with (Z=7,91 and p=0,00), which shows a significant positive relationship with overall FR. Here, a key characteristic of flexibility previously highlighted in the literature is structural complexity, which we also tested for (Craighead et al., 2007; Birkie et al., 2017; Chowdhury et al., 2019). Its relationship is found to be insignificant with firm resilience in our analysis. This suggest that a higher number of suppliers, customers and / or products in the supply network, more geographically dispersed SCs, for example, negatively impact resilience.

The results for SC Integration (H3) with corrected weighted mean effect size are: for SCI (r_c = 0,515), internal integration (r_c = 0,595), and external integration (r_c = 0,480). This shows a

significantly positive relationship of SCI and its dimensions with overall FR. SCI emerges as the most important antecedent SCC for firm resilience. Further, in the main effect analysis of (Hypothesis 4) firm resilience and performance relationship (Table 4), results show a significant positive association with firm performance (r_c = 0.486, CI_{95} = 0.400, 0.563). Particularly related with financial performance, hypothesis 4a shows a positive association but with a weaker effect (r_c = 0.269, CI_{95} = 0.114, 0.412). For hypothesis 4b, the results demonstrate a significant positive association for resilience and non – financial performance (r_c = 0.54, CI_{95} = 0.454, 0.617). Overall, in the main effect analysis, the above results provide support for hypotheses 1, 2, 3, and 4.

Moderation analysis

To conduct the moderator analysis, first we assessed whether there is an impact of moderating variables through calculating the Q-test and I^2. As it can be observed in Tables (3a, 3b, and 3c) the I^2 value is greater than the desired limit of 75%, which indicates true variance in the population relationship (Wang et al., 2018; Govindan et al., 2020). In this case, a moderator analysis (sub-group analysis) is suggested by Borenstein et al. (2009).

In the moderation analysis, first we tested the effect of different resilience operationalizations on the relationship between OC, SCF, and SCI with FR in subgroups (see Table 3a, 3b, and 3c). The effect sizes of OC – FR, as observable in their respective tables (for the dynamic, proactive and reactive temporal phases of resilience) are (r_c=0,415; Z=4,51, p=0,00), (r_c=0,567; Z=5,40, p=0,00), and (r_c=0,490; Z=7,41, p=0,00) respectively. For SCF – FR relationship, the effect sizes for dynamic, proactive and reactive temporal phases of resilience are (r_c=0,488; Z=2,69, p=0,01), (r_c=0,376; Z=5,10, p=0,00), and (r_c=0,468; Z=7,15, p=0,00) respectively. Finally, for SCI – FR

relationship, the effect sizes for dynamic, proactive and reactive temporal phases of resilience are (r_c=0,436; Z=7,97, p=0,00), (r_c=0,596; Z=8,74, p=0,00), and (r_c=0,546; Z=10,38, p=0,00) respectively. It could be thus observed that, at different temporal phases, the effect sizes of antecedent SCCs vary significantly. This suggest that the effectiveness of SCCs will be different at different resilience phases (before, during and after a disruption), thus leading to the acceptance of Hypothesis 5.

Additionally, we also performed subgroup analysis on two contextual variables: national culture and industry affiliation (see Table 5). To test whether cultural differences influence the relationships between organizational capability, SC flexibility, SC integration and firm resilience, we categorized studies into Western and Eastern culture. On the relationship between OC – FR, the corrected weighted mean effect size is stronger for Eastern culture (r_c=0,521) than the Western culture (r_c=0,410). For SCF – FR the relationship is stronger for Eastern culture (r_c=0,469) than the Western culture (r_c=0,433). Whereas, for SCI – FR the relationship is stronger for the Western culture (r_c=0,585) than the Eastern culture (r_c=0,473). For a subgroup of industry affiliation, in the relationships OC – FR, SCF – FR, and SCI – FR, the corrected weighted mean effect size is lesser for the traditional manufacturing sector than the various industries category (r_c=0,371 & r_c=0,551), (r_c=0,422 & r_c=0,478), and (r_c=0,444 & r_c=0,556) respectively.

Finally, we conducted the Q-test for homogeneity to assess the group differences in the subsamples (see Table 5). Since the p-values in the OC – FR, SCF – FR, and SCI – FR relationships for national culture (*p*=0,25; *p*=0,95; *p*=0,23) respectively are insignificant, the null hypothesis of homogeneity (national culture) in these SCCs – FR relationships is rejected. This suggests that antecedent SCCs

– FR relationships significantly vary across the national culture and group differences exist. In the case of industry affiliation, the p-values in the OC – FR, SCF – FR, and SCI – FR relationships (p=0,05; p=0,59; p=0,08) respectively are insignificant. This suggests significant group differences exist among different industries. This provides support for hypotheses 6 and 7.

TABLES 3a,3b,3c
Meta-Analytic results for Antecedent SCC – Firm Resilience
----------Insert Table 3a,3b,3c Approximately Here----------

TABLE 4
Meta-Analytic Correlations for Firm Resilience – Performance
----------Insert Table 4 Approximately Here----------

TABLE 5
Moderating Effects of Categorical Variables on Antecedent SCC – Firm Resilience
----------Insert Table 5 Approximately Here----------

5. DISCUSSION AND IMPLICATIONS

Our study presents a meta-analytic investigation of the relationship between the antecedent SCCs and firm resilience, as well as the relationship between firm resilience and performance. Despite the considerable amount of empirical evidence in the SC resilience literature, no earlier effort has been made to quantitatively aggregate present findings, to the best of our knowledge. As a result, a new theoretical framework for resilience is put forward, which advances current theory in the SC resilience domain. In total, we analyzed 56 independent sample studies published between 2000 - 2019 with a total sample size of 26,155 organizations. First, we reviewed the sampled studies to identify relevant SCCs impacting firm resilience. Second, we also examined meta-analytically the

relationship between firm resilience and firm performance to have a better understanding of the impact resilience can have on different performance indicators, financial and non-financial. Finally, we also investigated different moderating effects of: resilience conceptualization, national culture and industry affiliation to explain some of the observed variability in results.

We identify that SCCs have different magnitude effects, at different temporal phases, on resilience. This is a significant theoretical contribution, highlighting the fact that firms should prioritise the adoption of different sets of capabilities to prepare, stabilize, control and resist shocks (Conz and Magnani, 2020). Furthermore, we find that culture differences and industrial characteristics also influence the adoption of SC resilience mechanisms. Our study offers a detailed and significant account of differences in effect sizes in various subgroups.

The meta-analytic study reported in this paper is grounded in the Resource Based Theory (RBV), with an extension to the Contingency theory (CT). We identify and test the relationship of three antecedent SCCs with resilience: organizational capability, SC flexibility and SC integration. Our results explain that the correlation magnitude of different capabilities with resilience are positive and significant but different for FR in each category. While previous studies have highlighted SC flexibility as the most important and highly significant enabler for resilience, our meta-analysis further empirically validates other SCCs which appear equally important for resilience. We thus respond to the calls by Stone and Rahimifard (2018), Conz and Magnani (2020), and Shin and Park (2021) to empirically validate the relationship between SCCs and resilience. Further, our results are consistent with Fiksel (2015), who explained that resilience is a monetary investment and difficult to implement, therefore firms must assess the possible impact of disruptions before deciding on

what flexible capabilities to build. The results of our analysis can thus guide firms, when making investments in capabilities for resilience, particularly in terms of the relevance of such capabilities for the pre- and post- disruption phases.

Furthermore, the significance of resilience for firm performance is of an utmost importance. As firms consider investing into building flexible and resilient capabilities, their major concern is to what extent will firm performance be affected, both from a financial and operational perspective. Our study shows that the overall impact of resilience on firm performance is strongly significant. However, pertaining to the financial performance, the correlation magnitude shows a weaker to moderate effect. In addition, for non-financial performance, the resilience impact is strong and significant. Thus, by synthesizing the results of extant empirical studies we demonstrate that the beneficial impact of resilience is high mainly for the non-financial performance.

5.1.Theoretical implications

To the best of our knowledge, this is the first study that consolidates findings of empirical SC resilience studies through a meta-analytic review. We address previous calls by Stone and Rahimifard (2018) and Shin and Park (2021) to empirically explore the important antecedent SCCs for resilience. We also integrate the firm performance dimension to have a more comprehensive understanding of the concept of resilience. We contribute to the SC resilience field by aggregating findings of existing empirical studies, reconciling some previous inconsistent findings and obtaining the aggregated correlations for the SCCs – FR and FR – firm performance. Thus, we can confirm the generalizability and the validity of our results.

First, our study highlights to what extent different SCCs influence firm resilience and identify that SC Integration is the SCCs cluster with the highest impact on firm resilience, i.e., Supply Chain Integration, which is a significant theoretical implication. In the extant literature, studies such as Hohenstein et al. (2015), Tukamuhabwa et al. (2015), Ali et al. (2017); Ali and Golgeci (2019) and Han et al. (2020) have proposed various theoretical frameworks for resilience, but failed to empirically validate the influence of different SCCs on resilience. Furthermore, in the SC integration cluster, we also explored how two sub-clusters, internal and external integration, influence resilience. Internal integration appears more effective than external integration for improving firm resilience, which is a further significant contribution to theory. However, we call for further studies specifically exploring the impact of external integration on resilience, acknowledging that nowadays organisations are increasingly dependent of resources located outside their own boundaries. For example, studies could consider open innovation from an adaptive capacity SC perspective. Furthermore, while reviewing studies on SC integration, we observed that studies exploring external integration at SC level do not investigate whether the reported results vary for different levels of uncertainty. This is likely to significantly impact the magnitude of the achieved effects. Furthermore, extant empirical literature remains silent in terms of how different SC integration capabilities (information integration, operational integration, relational integration) (Leuschner et al., 2013) affects the resilience of suppliers and / or buyers while managing coopetition in the network (Wilhelm and Sydow, 2018).

Our study further extends existing theory in the resilience domain by investigating in-depth the relationship between SC flexibility and resilience. We find a positive association of flexibility with overall resilience and highlight the significant role of capabilities such as a flexible supply base,

reconfiguring resources, creating slack resources to lessen the impact of disruptions. Within the flexibility capabilities cluster, we also test for structural complexity (Craighead et al., 2007; Birkie et al., 2017; Chowdhury et al., 2019). Its relationship with firm resilience is found to be insignificant in our analysis. This suggest that a higher number of suppliers, customers and / or products in the supply network, more geographically dispersed SCs, for example, are likely to negatively impact resilience. This is particularly relevant in the current COVID-19 context, when the entire world faced serious disruptions (Ivanov and Dolgui, 2020; Belhadi et al., 2021). Food SCs, for example, reportedly struggled to respond due to high levels of complexities resulting from their geographical dispersion and increased levels of subcontracting, as well as adversarial practices between companies, that limited the level of integration and ability to respond. Post COVID-19, discussions are emerging again in terms of bringing manufacturing closer to markets and focusing on reducing the complexities associated with global SCs by making them shorter and more localized (Choi et al., 2020; Choi et al., 2021). Therefore, different approaches and strategies should be explored to manage extended supply networks (for further research directions, see Table 7). Furthermore, in terms of conceptualization of complexity, previous literature mainly explores SC complexity from a structural aspect, while more dynamic aspects should also be relevant and require more in-depth investigations (Ates et al., 2021).

Our research also focuses on conceptualizing *organizational capabilities*, spanning from innovation, technology, organizational culture & infrastructure, SC capability, strategic orientation and manufacturing capability, which further contributes towards understanding resilience. We find this cluster to have a significant impact on firm resilience. However, there is a paucity of research in the extant literature in exploring clusters of organizational capabilities in terms of the disruption

impact. To what extent any specific organizational capability is useful in managing different forms of complexities and uncertainties in a specific industry or economic region to enable resilience is an issue that warrants further investigation.

Our study also contributes to theory on in the resilience domain through specifically addressing the impact various resilience capabilities have on both financial and non – financial performance. The financial dimension yields a weaker but still positive relationship, possibly because developing resilient capabilities may, at least initially, attract large investments which can have a financial penalty. As for non-financial performance, by employing different SCCs, firm increase their resilience and this further leads to a positive impact on aspects such as operational performance, competitive advantage, customer value and service.

Thirdly, by studying the impact that *resilience operationalization* has on the relationships between SC capabilities – firm resilience – firm performance, additional theoretical implications emerge. We find that, for different resilient phases, the effect sizes of Organisational Competence, SC flexibility, and SC integration are significantly different. Thus, we empirically validate the claim raised by Conz and Magnani (2020) and Shin and Park (2021) regarding the fact that firms need different capabilities for resilience across a temporal continuum. This suggest that different capabilities play different roles at different temporal phases of resilience (pre-disruption and post-disruptions). We find that, for the proactive and reactive phases of resilience, the highest effect size pertains to SC integration, whereas for dynamic resilience it is SC flexibility who has a stronger effect. This is particularly relevant nowadays, with authors such as Ivanov (2019; 2021), Dixit et al. (2020), and Paul & Chowdhury (2021) calling for firms to be cautious in the post pandemic

recovery period, to avoid negative consequences of the disruption tail. Similarly, one of the highly cited resilient elements in the extant literature, SC flexibility, does not show the highest effect size both in the proactive and reactive phases. This, however, could be justified by the incomplete definitions of flexibility adopted in the identified studies. For example, though network reconfiguration (the ability to quickly re-configure the supply base) is considered essential in previous studies in order to increase flexibility and respond to unexpected disturbances (Christopher et al., 2000), none of the identified studies in our meta-analysis explore this aspect. Indeed, having a flexible structure of suppliers and transportation alternatives can positively impact resilience (Pereira and Da Silva, 2015; Beninger and Francis, 2021). Furthermore, due to the heterogeneity identified, more empirical studies on the said relationship are required.

Our study also reveals that two further moderating (contextual) factors, industry affiliation and national culture, influence the relationship between SCCs-FR. This highlights the importance of considering under what circumstances SCCs can significantly affect resilience. We found significant differences among Eastern and Western cultures regarding the adoption of SCCs to enable firm resilience. These results suggest that the SCCs – FR relationship framework should not be applied universally across countries. This finding is consistent with previous research that emphasizes the fact that geographical traits and cultural factors act as contingencies in adopting Operations & Supply Chain Management practices (Hofstede, 1991; Rungtusanatham et al., 2005; Talluri et al., 2013; Durach et al., 2017; Ciravegna et al., 2020). In the industry affiliation moderator category, the strength of the relationship between various SCCs-FR appears to be highest in the "various industries" category compared to the "traditional manufacturing" sector. Therefore, with regards to industry diversity, certain industries appear to integrate resilience principles into their

operations relatively easier. It is thus important to further explore why some industries are more oriented towards dealing with disruptions. For instance, competition intensity, buyer and suppliers' bargaining power, managers' decision-making experience, supply base rationalization may influence the FR level. These contextual variables should be explored further. Overall, it is thus argued that it is imperative for further studies to incorporate these contingencies when exploring the SCCs-FR relationship.

5.2.Managerial implications

Our research has significant implications for practitioners. We identify three categories of SCCs that have a significant but varying level of relationship with resilience, with a significant impact on financial and non-financial performance. Thus, managers should pay close attention to the practices whose adoption appear to yield the highest effects. Our findings suggest that SC integration emerges as a stronger enabler for both proactive and reactive resilience. Our study also identifies what SCCs have the highest benefit when adopted at different stages of resilience (pre or during / post disturbance). This knowledge, as highlighted by Brandon-Jones et al. (2014), will guide investment decisions in the SC. Further, the significant difference in the impact that resilience has on financial and non-financial performance can help top management consider resilience strategically. Furthermore, a lesser resilience level for firms observed in Eastern cultures for SC integration indicates that the uncertainty avoidance is low among Eastern countries, possible due to them possessing less rigid codes of behaviors, though relationships with their network partners appear less mature (Durach and Wiengarten, 2017). The lesser effect size between SCC-FR among manufacturing firms further indicates the need for more investment and efforts on product and process innovation in the manufacturing sector. This study also highlights to managers the

importance of having a diverse set of capabilities for resilience, and provides guidance as to what these capabilities are. Senior management should particularly consider developing internal integration capabilities to prepare themselves and avoid the impact of future disruptions, as this capability had the strongest identified effect. Furthermore, in relation to the complexity aspect, managers must first identify the root cause of vulnerabilities in their SC and only then develop tailored SC solutions and capabilities.

Finally, the strong relationship between resilience and non-financial performance should guide managers in perceiving resilience capabilities as a long-term investment rather than just a potential short-term financial liability. Resilience building capabilities are a significant source of competitive advantage.

5.3.Limitations and recommendations for future research

The results of this study should be interpreted in light of some limitations. First, the SC resilience literature is still growing, and the number of studies examining the SCC – FR and FR – firm performance relationships is fairly limited still (Hohenstein et al., 2015; Ali and Golgeci, 2019). However, due to the topical nature of resilience, more studies on the said relationships are expected in the very near future and another meta-analysis with a different approach (for instance, MASEM or mediated moderation model) could be performed to compare the reliability and robustness of the newly emerging results. Besides, different SC constructs were categorized into individual SCC clusters. However, there is a possibility that each category has not captured the full breadth of relevant SCCs. Although we addressed the heterogeneity in the main effects by using moderating factors, we were not able to perform moderation analysis within some of the sub-groups due to the

limited sample size/observations, such as the relationship between structural complexity - resilience, and internal / external integration - resilience. This prevented us from drawing further potentially interesting insights.

It also must be noted that a large number of identified studies belong to the manufacturing sector. This highlights that the service sector needs more attention for future research. Researchers must also identify, besides complexity drivers, what other factors in manufacturing industries weaken their resilience level. Also, future research should examine the relationship between SCC-FR in under-explored countries from advanced economies, such as Japan, as well as in emerging and developing economies, such as Pakistan, Brazil, and Latin America, for example. Moreover, due to the limited number of empirical studies on proactive resilience, we call for further research.

Future studies could also advance our results via moderator analysis from different economies based on income level, and through the five Hofstede dimensions of national culture. They should also consider contextual factors such as industry competition intensity, bargaining power, flexible or rationalized supply base, geo-political affairs and governance mechanism. Future studies in emerging and developing economies should also be conducted to assess the senior leadership's attitude towards adopting flexible approaches and creating technical infrastructure to improve resilience, particularly in small and medium firms confronted with asymmetries of power in SCs or in family firms (Talay et al., 2018; Ciravegna et al., 2020; Salvato et al., 2020). Additional research should also focus on the SCCs that either heighten or hinder resilience - this will further enhance the domain knowledge. A final proposed line of research relates to the fact that few studies exist investigating the impact of resilient capabilities on different dimensions of firm performance, such

as economic, financial and operational. An agenda for future research on SC resilience is summarized in Table 7.

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TABLE 1

Constructs	Sample Definitions
Organizational capability	Amit and Schoemaker (1993) defined organizational capability as a firm's ability to mobilise resources, typically in conjunction, adopting organisational mechanisms to achieve a specific goal. They are firm-specific, information-based, tangible or intangible processes that evolve over time owing to the complex interactions between the firm's resources. Wernerfelt (1984) described it as anything that is a firm's power. This study identified 6 types of organizational capabilities, such as, innovation, technology, organizational culture & infrastructure, supply chain capability, strategic orientations and manufacturing capability.
Supply Chain Flexibility	Flexibility is defined by Upton (1994) as the "ability to change or react with little penalty in time, effort, cost or performance". Firms are able to respond to market dynamism and manage risks by reconfiguring its resources (Slack et al., 2009; Chan, 2003). This study has identified 6 types of flexibility categories, such as, redundant/slack capacities, resource reconfiguration, agility, visibility, structural complexity.
Supply Chain Integration	It is defined as the extent to which firms strategically collaborate and cooperate with its network partners, and internal departments or functions to ensure continuous flow of material, information, and finances at low cost and during adverse circumstances to the downstream customers (Frohlich and Westbrook, 2001; Ataseven and Nair, 2017). Samples studies in this review has focused on internal and external integration.
Internal Integration	Koufteros et al., (2010) characterized internal integration as a cooperative and coordinative arrangement among various functions or departments within a single organization. Include measures of internal integration, information sharing, organizational learning, and training.
External Integration	EI refers the extent to which company understand its customers' and suppliers' interests, and collaborate with them to create inter-organizational plans, common activities, and procedures to meet those needs (Flynn et al., 2010). Include measures of external integration, logistics integration, customer integration, also measures on developing collaboration, cooperation, coordination and trust with external partners (Ataseven and Nair, 2017).
Proactive Resilience	It is defined as an ability to identify and monitor potential events, evolving conditions, and performance before the ability of the SC to function is jeopardized (Ali et al., 2017).
Reactive Resilience	It is defined as an ability to respond rapidly to disruptive events to resume operations to maintain its core functionality or to a new and desirable condition (Pereira et al., 2014).
Dynamic Resilience	It is an ability of a SC to be prepared for unexpected risk events, responding and recovering rapidly to risk events to return to its original state or grow by moving to a new equilibrium position, to increase customer service, market share and financial performance (Hohenstein et al., 2015).
Financial Performance	The firm performance measured from financial measures, return on assets (ROA), return on investment (ROI), profitability ratio, etc. (Yu et al., 2019; Li et al., 2017)
Non-financial Performance	Measuring the firm's operation performance, in terms of cost, quality, flexibility and delivery. Chowdhury & Quaddus (2016); Liu & Lee (2017).
	Achieving a unique position to stay ahead in the competition, in terms of superior performance, efficiency, distinction, prestige. (Kwak et al., 2018).
	Performance relative to its competition measured in terms of maximum output produced, quality control, flexibility to change volume, and reduce wastages.(Bozarth et al., 2009; Brandon-Jones et al., 2015).

Table 2

Publication bias tests

Relationship	k	N	Classic Fail Safe N	Egger's Intercept	p - value
Organizational Capability - FR	24	5133	8738	-5,17	0,33
OC - Dynamic Resilience	6	1130	348	-7,94	0,29
OC - Proactive Resilience	7	1527	1035	26,01	0,07
OC - Reactive Resilience	17	3848	4811	-4,75	0,54
Flexibility - FR	19	4236	4334	4,00	0,32
Flexibility - Dynamic Resilience	4	883	162	17,79	0,12
Flexibility - Proactive Resilience	4	972	146	10,12	0,45
Flexibility - Reactive Resilience	13	2866	2316	-0,74	0,87
SCI - FR	29	6917	5972	0,91	0,78
Internal Integration - FR	9	1885	1993	14,11	0,46
External Integration - FR	22	5340	7829	-0,40	0,89
SCI - Dynamic Resilience	6	1734	568	22,46	0,16
SCI - Proactive Resilience	10	2068	2421	0,30	0,96
SCI - Reactive Resilience	21	4959	9618	0,96	0,84
Resilience - Firm Performance	27	8473	31130	1,56	0,13
Res. - Fin. Perf	7	1792	319	1,86	0,10
Res. - Non Fin. Perf	22	6681	25078	1,47	0,15

Note: k = number of independent studies; N = total sample size; Classic fail-safe N= number of unpublished studies that would bring an Insignificant p-value of the cumulated effect size; Egger's intercept = Egger's regression intercept; p – value = significance value for Egger's Intercept.

TABLE 3a

Meta-Analytic results for Organizational Capability – Firm Resilience

				95 % C.I.				Homogeneity Test		
Relationship	**k**	**N**	**(r_c)**	**LL**	**UL**	**Z - Value**	**p - value**	**Q**	**p_Q**	**I^2**
Organizational Capability - FR	24	5133	0,481	0,388	0,565	8,90	0,00	400,63	0,00	94,3
Subgroup analysis based on resilience operationalization										
Dynamic	6	1130	0,415	0,245	0,561	4,51	0,00	51,37	0,00	90,3
Proactive	7	1527	0,567	0,388	0,704	5,40	0,00	126,49	0,00	95,3
Reactive	17	3848	0,490	0,375	0,590	7,41	0,00	314,76	0,00	94,9

Note: k = number of independent studies; N = total sample size; r_c = corrected weighted mean effect size; 95%CI, LL-UL = the lower and upper limits for the 95% confidence interval; Z – value = Z statistics; Q = test for estimating the heterogeneity; p_Q = Q statistics p-value; I^2 = percentage of variation in the effect sizes attributed to the inclusion of moderator variables.

TABLE 3b

Meta-Analytic results for flexibility – Firm Resilience

Relationship	k	N	(r_c)	95 % C.I. LL	95 % C.I. UL	Z - Value	p - value	Homogeneity Test Q	Homogeneity Test p_Q	Homogeneity Test I^2
Structural Complexity - FR	6	1396	-0,054	-0,344	0,245	-0,35	0,73	161,23	0,00	96,8
Flexibility - FR	19	4236	0,455	0,353	0,546	7,91	0,00	281,77	0,00	93,6
Subgroup analysis* based on resilience operationalization										
Dynamic	4	883	0,488	0,144	0,727	2,69	0,01	95,32	0,00	96,8
Proactive	4	972	0,376	0,239	0,498	5,10	0,00	16,88	0,00	82,2
Reactive	13	2866	0,468	0,353	0,569	7,15	0,00	164,48	0,00	92,7

Note: k = number of independent studies; N = total sample size; $\mathbf{r_c}$ = corrected weighted mean effect size; 95%CI, LL-UL = the lower and upper limits for the 95% confidence interval; Z – value = Z statistics; Q = test for estimating the heterogeneity; p_Q = Q statistics p-value; I^2 = percentage of variation in the effect sizes attributed to the inclusion of moderator variables. * Exclusive of structural complexity.

TABLE 3c

Meta-Analytic results for SCI – Firm Resilience

Relationship	Studies	Sample Size	(r_c)	95 % C.I. LL	95 % C.I. UL	Z - Value	p - value	Homogeneity Test Q	Homogeneity Test p_Q	Homogeneity Test I^2
SCI	29	6917	0,515	0,450	0,575	13,18	0,00	349,93	0,00	92,00
Internal Integration	9	1885	0,595	0,462	0,701	7,27	0,00	131,49	0,00	93,92
External Integration	22	5340	0,480	0,415	0,540	12,61	0,00	183,71	0,00	88,57
Subgroup analysis based on resilience operationalization										
Dynamic	6	1734	0,436	0,338	0,524	7,97	0,00	29,31	0,00	82,94
Proactive	10	2068	0,596	0,487	0,686	8,74	0,00	110,13	0,00	91,83
Reactive	21	4959	0,546	0,460	0,622	10,38	0,00	335,29	0,00	94,03

Note: k = number of independent studies; N = total sample size; $\mathbf{r_c}$ = corrected weighted mean effect size; 95%CI, LL-UL = the lower and upper limits for the 95% confidence interval; Z – value = Z statistics; Q = test for estimating the heterogeneity; p_Q = Q statistics p-value; I^2 = percentage of variation in the effect sizes attributed to the inclusion of moderator variables.

TABLE 4

Meta-Analytic Correlations for Firm Resilience – Performance

Relationship	k	N	(r_c)	95 % C.I. LL	95 % C.I. UL	Z - Value	p - value	Homogeneity Test Q	Homogeneity Test p_Q	Homogeneity Test I^2
Res -> Firm Performance	27	8,473	0.486	0.400	0.563	9.72	0.00	937.86	0,00	95.95
Res -> Financial Perf	7	1,792	0.269	0.114	0.412	3.34	0.00	91.83	0,00	91.29
Res -> Non Financial Per	22	6,681	0.540	0.454	0.617	10.28	0.00	655.51	0,00	95.58

Note: k = number of independent studies; N = total sample size; $\mathbf{r_c}$ = corrected weighted mean effect size; 95%CI, LL-UL = the lower and upper limits for the 95% confidence interval; Z – value = Z statistics; Q = test for estimating the heterogeneity; p_Q = Q statistics p-value; I^2 = percentage of variation in the effect sizes attributed to the inclusion of moderator variables.

TABLE 5

Moderating Effects of Categorical Variables on Antecedent SCC – Firm Resilience

Moderators (Subgroup Analysis)	k	N	(r_c)	95 % C.I.		Q_b	p – value
				LL	UL		
Organizational Capability - FR							
Manufacturing	10	1975	0,371	0,217	0,507	4,16	0,05
Various	14	3158	0,551	0,445	0,643		
Culture							
Western	9	1826	0,410	0,241	0,555	1,34	0,25
Eastern	15	3307	0,521	0,406	0,620		
Flexibility - FR							
Manufacturing	8	1944	0,422	0,251	0,567	0,30	0,59
Various	11	2292	0,478	0,341	0,595		
Culture							
Western	7	1751	0,433	0,247	0,589	0,10	0,95
Eastern	11	2299	0,469	0,326	0,591		
Supply Chain Integration - FR							
Manufacturing	11	2781	0,444	0,331	0,545	2,98	0,08
Various	18	4136	0,556	0,479	0,624		
Culture							
Western	10	2529	0,585	0,482	0,672	2,92	0,23
Eastern	18	4092	0,473	0,385	0,551		

Note: k = number of independent studies; N = total sample size; r_c = corrected weighted mean effect size; 95%CI, LL-UL = the lower and upper limits for the 95% confidence interval; Q_b = between group test of homogeneity; p = p value of the Q_b statistics.

Table 6

Detail of Constructs Used in sampled studies for Meta-Analysis

SC Capability Dimensions	SC Capabilities - Measure	Description	Sample Studies
Organizational Capability	Big Data Analytics Capability	Planning, investment, coordination and execution in adopting Big Data Analytics technology.	Mandal (2018), Singh and Singh (2019), Dubey et al. (2019)
	Other Technological Capability	Technological tools to improve communication and internal firm assessment.	Mandal and Saravanan (2019), Singh and Singh (2019), Mandal (2019)
		Utilizing recent technologies to develop innovative services	Kim et al., (2013)
	Supply Chain Capabilities	Firm's internal demand & supply management capability.	Mandal b (2017)
		Stable logistics capability to protect material and information flow.	Kwak (2014), Yang and Hsu (2018)
		The extent to which a firm is genuinely interested in the supplier's welfare; firm's willingness to make some sacrifices. Investment in developing SC disruption skills.	Verghese et al., (2019); Durach and Machuca (2018)
	Manufacturing	Internal plant ability to remanufacture damaged products, Deploying appropriate management measures to control and improve the production and delivery processes.	Bag et al. (2019), Cheng and Lu (2017).
	Strategic Orientations	Proactive and innovative practices for risky ventures.	Mandal and Saravanan (2019)

		Environmental awareness across all departments. Firm's managers ability to think beyond the conventional regime. Acknowledging the importance of supply chain management in achieving performance.	Chowdhury & Quaddus (2017), Ponomarov (2012)
	Organizational Culture	Improving operational routines and procedures Joint efforts shared by the firm's members Formal procedures, routines & decision making mechanism Rewards protocols for employees Top management support in terms of management attitude in providing strategic resources	Cheng and Lu (2017). Mandal c (2017), Riley (2013) Shqairat and Sundarakani (2018)
	SC Risk Management Culture	Favourable culture on risk assessment and mitigation.	Ponomarov (2012), Ambulkar et al. (2015), Yu et al. (2019), Li et al., (2019).
	Firm Innovativeness	Utilizing innovative technologies, processes, and new ideas	Golgeci and Ponomarov (2013), Golgeci and Ponomarov (2015), Kwak et al., (2018).
	Absorptive Capacity	Firm's expertise to recognise the value of new information and use it for commercial ends.	Cheng and Lu (2017)
Supply Chain Flexibility	Redundancy/Slack capacities	Maintaining extra capacity, carrying safety stocks, alternate transportation modes. Setting up alternative production contingency plans	Zineb et al. (2017), Park (2011), Shqairat and Sundarakani (2018), Brusset and Teller (2017)
	Agility	Enhanced responsiveness to changing market needs	Shao (2013), Lee and Rha (2016) Mandal et al. (2016), Nikookara et al. (2019)
	Visibility	Tracking the rapid changes in market conditions Perceive potential opportunities in the SC. Visible inventory & demand levels across the SC Sensing the potential opportunities and threats in our SCs.	Mandal (2017), Lee and Rha (2016), Dubey et al. (2018), Mandal et al. (2016), Mandal (2017), Brandon-Jones et al. (2014), Shao (2013), Naghshineh and Lotfi (2019), Mandal and Saravanan (2019), Nikookara et al. (2019) Lee and Rha (2016).
	Resource Reconfiguration	Adaptive capacity of sites Extent of postponement Reconfiguration of resources as per environmental setting	Zineb et al. (2017), Brusset and Teller (2017), Park (2011), Mandal et al. (2016), Lee and Rha (2016), Ambulkar et al. (2015), Singh and Singh (2019). Nikookara et al. (2019), Parker and Ameen (2018).
	Structural complexity	Supply Base scattered in the network, supply base complexity.	Shao (2013), Birkie et al. (2017), Brandon-Jones et al., (2014), Friday (2018), Chowdhury et al., (2019).
Supply Chain Integration	Internal Integration	Internal Integration within an organization. Disruption Orientation Learning and development, Training. Logistics information.	Li et al. (2019), Liu and Lee (2018), Riley et al. (2016). Ambulkar et al., (2015), Yu et al. (2019). Chowdhury & Quaddus (2017) Kwak (2014).
	External Integration	External Integration Customer & Supplier Integration	Li et al. (2019), Shao (2013). Brusset and Teller (2017), Liu and Lee (2018), Ponomarov (2012)

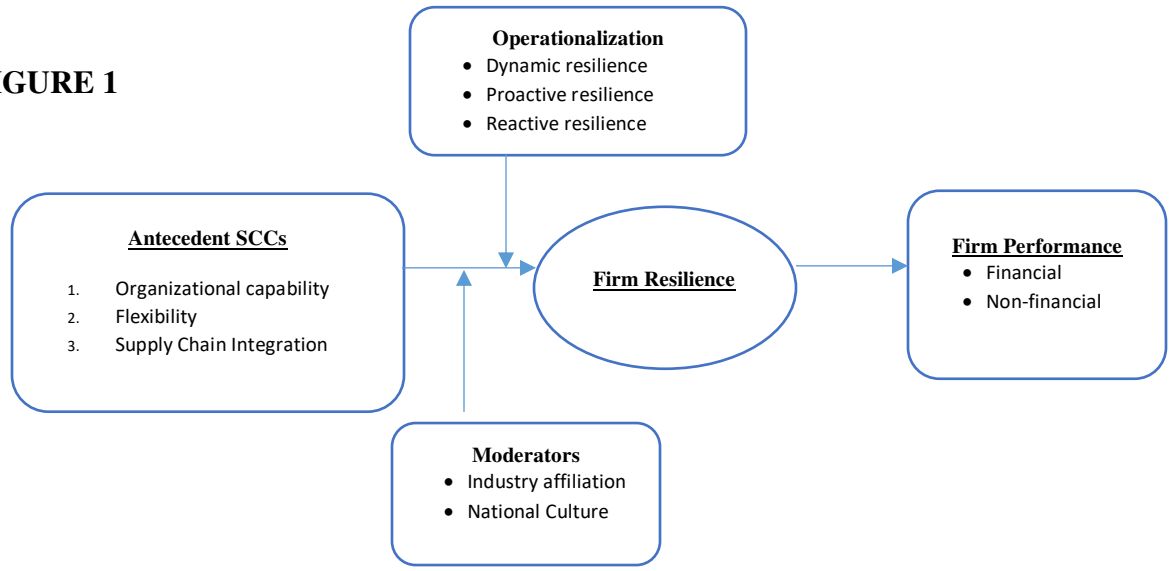
		Developing collaboration, coordination, cooperation, trust and relationships with external members.	Glassburner (2018), Chowdhury et al. (2019), Randall (2012), Friday (2018), Kwak (2014), Dubey et al. (2018), Durach et al. (2018), Nikookara et al. (2018), Gölgeci and Kuivalainen (2019), Liu and Lee (2018), Mandal and Saravanan (2019), Mandal (2015), Mandal (2015c), Mandal et al. (2017), Mandal and Sarathy (2018), Wieland and Wallenburg (2013), Yang and Hsu (2018), Zineb et al. (2017).

Table 7

Future research agenda

Future Research Questions in Supply Chain Resilience
Complexity and Resilience
How does the combined interplay of different types and conceptualizations of supply chain complexities affect resilience and firm performance? Are all types of supply chain complexities negatively impacting resilience? To what extent do different operational and strategic capabilities play an intervening role for different types of complexities and what is their impact on resilience and performance? How does the interplay between the Lean, Agile, Resilient, Green and Sustainable paradigms impact the complexity -performance relationship? To what extent do various digital technologies impact firm resilience and performance?
Disruption Impact and Resilience
To what extent does a disruption propagate (on both the supply and demand side) in a specific industry setting after a disruptive event (trade war, fire incident, currency fluctuation, etc.) and is the propagation symmetrical? What financial and operational decisions can firms take to improve resilience?
Knowledge Management and Resilience
To what extent are knowledge spillovers effective in dealing with disruptions and leveraging resilience in Eastern and Western cultures, or in Advanced and Emerging & Developing economies? What is the role of knowledge management in enabling digital technologies to support firms in achieving their strategic plans, like sustainability, resilience, corporate performance?
HR, Leadership and Resilience
To what degree do managerial skills (complex problem solving, critical thinking, creativity, people management skills) influence a firm's collaboration and decision-making ability and how do they impact resilience? For Eastern and Western cultures or different sizes of firms, what is the role of leadership competencies in dealing with mega disruptions (global pandemic) to assure business continuity?
SC Integration and Resilience
To what extent are relational strategies and network alliance capabilities significant (for instance, under a JIT environment) for improving resilience when faced with a disruption? How do static and dynamic network complexities impact the level of SC integration achieved and resilience?

FIGURE 1


Operationalization
Dynamic resilience
Proactive resilience
Reactive resilience
Antecedent SCCs
1. Organizational capability
2. Flexibility
3. Supply Chain Integration
Firm Resilience
Firm Performance
Financial
Non-financial
Moderators
Industry affiliation
National Culture