Impact of strategic and operational risk management practices on firm performance: An empirical investigation

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Title Page

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Abstract:

Increasingly, creating and delivering value through complex supply chain networks involves substantial risks. However, strategy development under business risk conditions is not well-understood. This cross-country research examines how, under conditions of supply chain network risk, firms develop effective risk management practices. Using a literature review and survey research of managers from global firms; we present a research model, and empirically test the hypothesized relationships. The results show that under conditions of uncertainty, management decision-making is more likely to be cautious until visible forms of risks emerge, and prudent response mechanisms are put in place. This study identifies the crucial role of supply chain exploration and exploitation practices, and their influence in development of network risk management practices, leading to competitive financial outcomes.

Key Words: Global Supply Chain; Strategy; Exploration practices; Exploitation practices; Network Risk Management; Firm Financial Performance.

Impact of Strategic and Operational Risk Management Practices on Firm Performance: An Empirical Investigation[1]

1. Introduction

As firms expand their operations globally, they have to sustain their market successes despite supply chain risks. Complex global supply chain networks increase the possibility of a negative impact of potential supply chain disruptions on firm performance. Of particular concern is the role played by suppliers and how small failures at their end may magnify supply chain risk factors for the buyer firm (Kim, Wagner, & Colicchia, 2019; MacKenzie, Barker, & Santos, 2014). Although assuring a total risk-free supply chain is almost impossible, organizations still can develop a resilient supply chain network that recovers from shocks faster than competitors (Brandon-Jones, Squire, Autry, & Petersen, 2014; Hohenstein, Feisel, Hartmann, & Giunipero, 2015). Therefore, in recent years researchers have increasingly paid attention to how firms can develop supply chain risk resilience (Eckerd & Girth, 2017; Singh & Singh, 2019). In focus particularly has been the role of senior management in identifying risks in advance, and implementing the right responses at both firm and network levels (Wieland, 2013). However, despite vigorous research in risk management, much still remains unclear about how firms identify potential supply chain risk events, and consequently develop effective response mechanisms (Kilubi, 2016; Kurniawan, Zailani, Iranmanesh, & Rajagopal, 2017).

Although organizations may experience serious catastrophic disruption events (e.g., earthquake, tsunami, nuclear disaster) once every decade, they struggle with competitive pressures on a daily basis. The challenge therefore is to prepare for low probability of major disastrous risks without stifling routine competitive requirements (Lima, Crema, & Verbano, 2020). This is particularly relevant for firms that witness occasional supplier failures, and the

[1] We would like to thank the two anonymous reviewers and the Managing Editor for their constructive feedback and help that enabled us to significantly improve the quality of the article.

resulting damage within their supply chain network (Kim et al., 2019). In response to these long-term risk uncertainties and short-term disruptive events, scholars have attempted to understand how firms develop Supply Chain Risk Management (SCRM) practices, and the impact of these practices on organizational financial performance (Hendricks & Singhal, 2005; Lavastre, Gunasekaran, & Spalanzani, 2014; Wieland & Wallenburg, 2012). As this stream of literature has evolved, one area that remains understudied is the relationship between explorative orientation of strategic risk management and exploitative nature of operational risk management (Swanson, Goel, Francisco, & Stock, 2018)

In light of these perspectives, this article focusses on two main research questions: (1) How do network risk drivers define strategic and operational supply chain practices? and (2) How do supply chain risk management practices mitigate supply chain risks and achieve desirable firm financial performance? To examine these research questions, we first conduct a literature review that enables us to identify gaps in the literature. We then present a research model that defines key constructs that explain the causal relationships for developing supply chain network risk management practices. The hypothesis development section examines the relationships between supply chain network risk drivers, supply chain exploration and exploitation practices, risk management practices, and performance outcomes. Empirical tests are then conducted on data collected from global respondents. We conclude with our research findings and discuss their implications.

2. Literature review

In a crowded global marketplace, firms develop a business strategy to achieve competitive advantage. Recently, the role of enhanced supply chain networks in developing such an advantage has attracted increasing research attention (Koufteros, Verghese, & Lucianetti, 2014;

Rosenzweig & Easton, 2010). An important aspect of supply chain strategy is to manage risk from the external network environment and internal organizational factors that, "result in the inability of the purchasing firm to meet customer demand or cause threats to customer life and safety" (Zsidisin, 2003:15). Therefore, an effective supply chain risk management requires a better understanding of the various types of supply chain risks and organizational response mechanisms to mitigate the negative impact of such disruption events (Hendricks & Singhal, 2005).

Although there exist several types of risk that can impact an organization's supply chain network, the term 'Catastrophic Risk' has been frequently used to refer to both man-made risks (terrorist strikes, labor unrest, supplier failure) and natural risks (floods, hurricanes etc.) (Knemeyer, Zinn, & Eroglu, 2009). Within this broad risk categorization, the strategic selection of supplier has emerged as an important research agenda in the SCRM literature (Alikhani, Torabi, & Altay, 2019). This is particularly important as firms have steadily increased out-sourcing and off-shoring of manufacturing and R&D activities, and heightened collaboration with international supplier partners (Gold & Schleper, 2017). Ever-expanding global market segments of particular products require an additional increase of supply base that often includes hundreds or thousands of suppliers. Such a high level of supply base complexity equates to a higher level of supply-related risk in terms of suppliers' financial stability and availability of their physical facilities (Kiser & Cantrell, 2006). As suppliers assume bigger roles in achieving competitive outcomes, an adverse event and the subsequent supplier failure might result in a significant negative impact on the organizational supply chain and business performance (Eber, Vega, & Grant, 2019; Habermann, Blackhurst, & Metcalf, 2015). Therefore, organizations working with a network of suppliers focus on developing risk management practices, aiming at

risk mitigation and supply chain resilience (Kiser & Cantrell, 2006; Ambulkar, Blackhurst, & Cantor, 2016; Gölgeci, Murphy, & Johnston, 2018).

Most research of supply chain risk management has focused on topics such as supplier selection (Cagnin, Oliveira, Simon, Helleno, & Vendramini, 2016; Vlachakis, Mihiotis, Pappis, & Lagoudis, 2016), supplier relationship management (Cheng & Chen, 2016), reputational risk (Petersen & Lemke, 2015), and supplier collaboration (Zhu, Krikke, Caniëls, & Wang, 2017). Therefore, a particular research need is to identify how supply chain network risk drivers impact organizational decision-making and resulting strategy development (Heckmann, Comes, & Nickel, 2015). In the absence of a structured assessment of how supply chain network risk impacts organizational risk management strategies, it is difficult to identify the steps organizations can adopt to develop risk resilience (Alikhani et al., 2019). These discussions therefore suggest several important research avenues. First, although scholars agree that supply chain strategy is an important element of firm business strategy, and can enable organizations to develop a competitive advantage, further focus is required to understand how organizations develop such a strategic outlook. Second, additional research needs to be conducted to develop a better understanding of how strategy development comes about under conditions of risk, especially within a global supply chain perspective. Studies tend to primarily approach the issue from an operational efficiency perspective but fail to consider the organizational and managerial context when it comes to understanding the process of strategy development. Third, the majority of scholars have discussed the topic from a single country perspective (Ho, Zheng, Yildiz, & Talluri, 2015). However, supply chain networks are now much more global in scope, and therefore it is important for research studies to factor in the global dimensions of risk on an organizational supply chain network.

3. Research model and hypotheses development

To develop a better understanding of how organizations can mitigate the disruptive impact of business risks emanating from the organizational supply chain network, we develop a theoretical model and corresponding hypothesis (Figure 1). This model attempts to link the risk drivers of the supply chain network to firm financial performance, through the medium of organizational learning and strategic practices.

3.1. Network risk drivers, supply chain exploratory and exploitative practices

The business environment in which firms operate has a major influence on the type of risks that they face. Environmental factors, such as man-made events (e.g., the Bhopal gas leak, the Deepwater Horizon oil spill) and natural disasters (e.g., pandemics, wild fires, floods, tsunami), especially have a significant impact on the supply chain network of a firm (Fridgen & Zare Garizy, 2016). These events can directly or indirectly impact the firm by creating disruption anywhere within the firm's global supply chain (Chen, Liu, & Yang, 2015; Lockamy III, 2014; MacKenzie et al., 2014). Another main cause of supplier risk is related to supply base complexity in terms of the number of suppliers, degree of differentiation among suppliers, supplier financial stability, the condition of supplier physical facilities, and the level of inter-relationships among the suppliers (Choi & Krause, 2006; Liao, Hong, & Rao, 2010; Yoon, Talluri, Yildiz, & Ho, 2018). Such a relationship between suppliers, purchasers and the focal firm is defined as an organizational supply chain network (Park, Min, & Min, 2016). Disruptions within an organizational supply chain network tend to have a ripple effect throughout the organization (Chopra & Sodhi, 2014). The term, `network risk drivers' therefore refers to the potential threats that an organization faces within its supply chain network from suppliers

because of their weak quality practices, inefficient delivery mechanisms, or inadequacy to meet fluctuating customer demands. These risk drivers motivate organizations to develop response mechanisms to manage such events and minimize negative financial impacts (Chen et al., 2015; Lockamy III, 2014; MacKenzie et al., 2014). Galbraith (1973, 1974) argued that as environmental complexity increases, organizational design is more likely to focus on effective use of relevant information. This is especially true for firms that are operating in conditions of high uncertainty. Organizations use quality information to respond to environmental uncertainty and improve their decision-making capabilities (Premkumar, Ramamurthy, & Saunders, 2005). Furthermore, organizations coordinate actions using rules, hierarchy, targets and goals to resolve such exceptional scenarios (Srinivasan & Swink, 2017). It is therefore important for firms to constantly scan their operating environment, strategize, and respond accordingly; as environmental uncertainty can "be managed if one has the correct information and good knowledge about the problem" (Riabacke, 2006:5). Therefore, an effective response mechanism to supply chain disruptions involves intra- and inter-organization information-sharing that improves combinative competitive capabilities (Riabacke, 2006; Kristal, Huang, & Roth, 2010; Miller & Roth, 1994).

(Figure 1 Here)

Within the manufacturing and IT strategy literature, the concept of combinative competitive capabilities is well-established (Hwang et al., 2015; Kristal et al., 2010; Miller & Roth, 1994; Skinner, 1978). Combinative competitive capabilities are operationally defined as "a manufacturer's ability to excel simultaneously on quality, delivery, flexibility, and low cost" (Kristal et al., 2010:417). "Combinative capabilities require a manufacturing firm to have two temporal orientations – the present and the future – and demand advancement on multiple

capabilities to prepare for today and tomorrow's changing competitive landscapes (e.g., price wars, quality wars, flexibility wars, etc.)" (Kristal et al., 2010:418). In addition, combinative capabilities enable manufacturing firms to conduct "better front-end planning to enable timely coordination (i.e., configurable), continuous interactions (i.e., adaptable), and organization-wide application (i.e., integrative)" (Hwang et al., 2015: 1). This idea when integrated with the theoretical concept of dynamic capability gives rise to two perspectives: managerial exploration practices and managerial exploitation practices (Im & Rai, 2008; Kristal et al., 2010).

The concepts of exploration and exploitation practices were initially proposed by March (1991). He argued that exploratory and exploitation practices within an organization play an important role in identifying and creating new opportunities and products for a firm (March, 1991). This viewpoint was further re-conceptualized by Subramani (2004) when he suggested that exploration and exploitation practices are instrumental in enabling organizations to develop supply chain management systems. He further argued that supply chain exploration and exploitation practices are two complementary patterns of a supply chain decision-making framework. Exploitation practices will therefore result in improved firm capabilities resulting in "clearly definable benefits (e.g., cost reduction, process consistency, process efficiency" (Subramani, 2004:49), while exploration practices will enable firms to create new capabilities which will assist managers in being able to devise "novel solutions to current problems" (Subramani, 2004:49). Lee & Rha (2016) further suggest that exploration and exploitation practices can lead to firms developing ambidexterity, and eventually dynamic capability. Scholars further contend that while exploitation utilizes existing resources and current competitive advantage, exploration is aimed at searching for new resources and expanding markets. Exploratory processes are proactive, diagnostic, and strategic in nature for firm resource

deployment configurations (Dyer, Gregersen, & Christensen, 2011; Lee & Rha, 2016; March, 1991; Ojha, Struckell, Acharya, & Patel, 2018). Thus, supply chain exploration practices involve searching for supply chain solutions based on novel approaches and seeking creative ways to satisfy customers. (Kristal et al., 2010; Lee & Rha, 2016; Lennerts, Schulze, & Tomczak, 2020). Exploitation practices, on the other hand, are considered as responsive, actionable, and operational in nature for firm resource deployment configurations (Dyer et al., 2011; Maletič, Maletič, Dahlgaard, Dahlgaard-Park, & Gomišček, 2014; March, 1991). Therefore, supply chain exploitation practices focus on maintaining a relationship with current suppliers, searching supply chain solutions using existing resources, and leveraging current supply chain technologies (Gualandris, Legenvre, & Kalchschmidt, 2018; Koufteros et al., 2014).

For the purpose of our study, we define network risk drivers in terms of suppliers' weak quality practices, poor delivery performance records, and inadequate suppliers' capabilities (Choi & Krause, 2006; Liao et al., 2010; MacKenzie et al., 2014; Yoon et al., 2018). Supply disruptions because of these network risk drivers are related to imperfection in supply chain complexity. Supply chain disruptions arising from these potentially damaging failures of suppliers may disturb routine information flows and thus increase environmental uncertainty. With such adverse impact of supply chain disruption events, the organization is more likely to focus on the current trials and troubles. Therefore, an organization might not be able to engage in proactive and long-term supply chain exploration (XPLOR) practices. Furthermore, as the organization has to allocate its resources to resolve immediate concerns at hand, supply chain exploitation practices (XPLOY) tend to focus on specific operational issues instead of improving broad level organizational collaborative issues. Even the development of supply chain risk

management (SCRM) tends to emphasize the pressing issues ahead. In relation to supply chain network risk drivers (SCNRD), the hypotheses therefore are:

H1a: Supply chain network risk drivers (SCNRD) negatively impact supply chain exploration (XPLOR) practices.

H1b: Supply chain network risk drivers (SCNRD) negatively impact supply chain exploitation (XPLOY) practices.

H1c: Supply chain network risk drivers (SCNRD) negatively impact supply chain risk management (SCRM) practices.

3.2. Supply chain exploration, exploitation, and risk management practices

As firms expand their operations to global market environments, the chances of supply chain disruptions also multiply (Truong & Hara, 2018). Although numerous perspectives exist on this topic, the role of organizational learning as a tool to mitigate disruption impact has gained prominence. Organizational learning is defined as "the process of improving actions through better knowledge and understanding" (Fiol and Lyles, 1985:803) which is becoming an important strategic priority of innovative organizational leadership (Ojha et al., 2018; Vera & Crossan, 2004). Organizational learning is regarded as an essential dimension of both exploration and exploitation practices, which are complementary in nature, and enable firms to develop dynamic capabilities (Ojha et al., 2018). Exploitation and exploration achieve differing goals and require diverse competencies and risk-taking behaviors (Levinthal & March, 1993). However, if a firm applies both exploration and exploitation, it can achieve economies of knowledge (Gibson & Birkinshaw, 2004). From a supply chain risk mitigation perspective, such exploration and exploitation practices will allow the firm to design effective response mechanisms to disruption events (Ojha et al., 2018). Exploration aims to discover opportunities for a better future, while

exploitation seeks to deliver desirable outcomes at the present (Im & Rai, 2008; Dyer et al., 2011).

Kristal et al. (2010) extending the idea of exploration, defined supply chain exploration as a process that involved "developing new supply chain competencies and useable external knowledge through complex searching, experimenting, and acquiring of new supply chain processes, resources, and technologies." (Kristal et al., 2010: 418). Therefore, supply chain exploration practices can enhance a manufacturers ability to respond rapidly in a dynamic environment and identify new business opportunities (Kristal et al., 2010). Dyer, Gregersen, and Christensen (2011) have identified five traits associated with exploratory practices, namely: associating, questioning, observing, idea networking and experimenting. Exploratory practices are therefore responsible for idea generation and developing radical and innovative solutions to existing problems (Subramani, 2004). Dyer, Gregersen, and Christensen (2011) further argue that exploration practices are strategic in nature and have a strong impact on risk management capabilities. We therefore extend these definitions to define supply chain exploration practices (XPLOR) as those practices developed by senior and middle managers that are innovative, preventive in responding to supply chain disruptions, and enable firms to develop risk mitigation capacity.

Supply chain exploitation practices (XPLOY) on the other hand "focuses managerial attention towards leveraging current manufacturer's capabilities by improving existing SC (supply chain) processes and technologies, as well as rationalizing and reducing supply costs. As a result, SC exploitation will strengthen a firm's current core competitive advantages" (Kristal et al., 2010: 418). Exploitative activities tend to increase the efficiency of the technical system by leveraging experiential learning gained through the repetition of routines. This process of

incremental learning reinforces and deepens organizational capabilities along a given technological trajectory (Benner & Tushman, 2002; He & Wong, 2004). Dyer, Gregersen, and Christensen (2011) suggest that exploitation practices are relevant more at the operational level and result in process and execution capabilities development. They further argue that delivery-driven skills required in top- and middle-level managers include analyzing, planning, detail-oriented implementing and self-discipline (Dyer et al., 2011). Therefore, we define supply chain exploitation practices as those initiatives taken by senior and middle managers that focus on operational and process improvement in an organizational supply chain, with the aim of developing risk mitigation capacity within the firm. The interplay between supply chain exploration and exploitation practices allow firms to develop dynamic capabilities and achieve desirable goals in the emergence of risk mitigation practices to manage supply chain disruption events.

From an organizational perspective, the global supply chain network of a firm includes both suppliers as well as supplier partners (Sharma & Blomstermo, 2003). When organizations face disruptions to their supply chain network from any of these actors, it has a potentially negative impact on firm performance (Zsidisin, Petkova, Saunders, & Bisseling, 2016). Therefore, SCRM practices are related to the firm's ability to manage specific risks emanating from the firm's supply chain network (supplier and sourcing partners) (Yoon et al., 2018). These practices focus on reducing uncertainties that come about due to fluctuations in product quality, cost, delivery, flexibility, capacity, and other supplier behavior that might have an impact on focal firms (Chavez, Yu, Jacobs, & Feng, 2017). They also focus on practices developed by an organization to engage in supplier management, supplier training, and developing joint risk management initiatives with suppliers and their partners (Radhakrishnan, Davis, Sridharan, Moore, & David,

2018). Such practices within an organization aim at developing redundancy plans in case of supplier inability to meet expectations. SCRM practices therefore aim to improve the operational capabilities of existing systems and processes within the firm's supply chain (Park et al., 2016). These practices result in network-focused risk management capability development. Since, supply chain exploration practices are formulative front-end strategies and supply chain exploitation practices are implementational back-end operations, they tend to have a positive impact on the early stage and the later stage of supply chain risk management practices. Therefore, based on these perspectives the corresponding hypotheses are:

H2a: Supply chain exploration (XPLOR) practices positively impact development of supply chain risk management (SCRM) practices.

H2b: Supply chain exploitation (XPLOY) practices positively impact development of supply chain risk management (SCRM) practices.

3.3. Supply chain risk drivers, supply chain risk management practices and firm financial performance

An important tangible outcome of strategic practices (SCRM practices) is improved financial performance of a business organization (Rădulescu, Ioan, & Nâstase, 2016; Shi & Yu, 2013; Urciuoli & Hintsa, 2016). Financial indicators commonly used to identify firm financial performance are profit (Hooley & Lynch, 1985; Saunders & Wong, 1985), turnover (Frazier & Howell, 1983), return on assets (Shi & Yu, 2013) and return on capital employed (Frazier & Howell, 1983). Supply chain network risk drivers in the form of various supplier failures are likely to damage the normal flow of goods and services within the supply chain (Bode, Wagner, Petersen, & Ellram, 2011; Craighead, Blackhurst, Rungtusanatham, & Handfield, 2007). Such deficiencies may increase quality defects, incur additional costs, slow down delivery time

(Davis, Eisenhardt, & Bingham, 2009; Nunes, 2018; Pfohl, Kohler, & Thomas, 2010; Sirmon, Hitt, & Ireland, 2007), and eventually negatively impact firm financial performance (FP) (Zsidisin et al., 2016).

Supply chain risk management practices therefore include firm-specific proactive activities (e.g., long-term risk assessment, defining performance improvement goals) and network-based preventive activities (e.g., involving suppliers for strategic risk initiatives, education and training of risk monitoring, implementing lean management goals across the supply chain) (Ghadge, Dani, & Kalawsky, 2012; Rotaru, Wilkin, & Ceglowski, 2014; Sodhi, Son, & Tang, 2012; Tummala & Schoenherr, 2011). These activities are positively associated with firm profitability as they reduce accident-related costs, enhance quality performance, better utilize organizational resources, and improve customer satisfaction measures (Allen & Helms, 2006; Thun & Hoenig, 2011; Wieland & Wallenburg, 2012). As shown in Figure 1, supply chain risk drivers are positioned in the front-end of organizational process and thus they are somewhat remotely but negatively related to financial performance; whereas supply chain risk management practices function in the back-end of organizational process, and thus are more closely and positively related to financial performance. Therefore, we argue that both supply chain risk drivers and supply chain risk management practices affect financial performance measures (e.g., firm profitability, market share, sales growth and return on assets) substantially, and yet differently. Therefore, hypothesis three (H3) and four (H4) are:

H3: Supply chain network risk drivers (SCNRD) negatively impact firm financial performance (FP).

H4: Supply chain risk management practices (SCRM) positively impact firm financial performance (FP).

4. Methodology

4.1. Research methodology

The study adopts a quantitative approach which involves development of a survey instrument, and the use of covariance-based structural equation modelling (CB-SEM) to investigate the hypothesized relationships. The first step in developing valid scientific measures centers on specifying the domain of the construct through a comprehensive review of the literature. We used the existing literature base to develop the model identified in Figure 1 and generate the survey instrument (Bagozzi, Yi, & Phillips, 1991; Churchill, 1979; Moore & Benbasat, 1991). We adopt a questionnaire-based survey method as it enables a researcher to gather and test the relationships between various constructs on a large sample base, increasing generalizability of the findings (Miller, 1992; Straub, Boudreau, & Gefen, 2004). The unit of analysis in our study is the firm level.

4.2. Data collection and sample characteristics

Items for the constructs were developed from established scales altered to the context of our study. The items for supply chain network risk drivers were adapted from the scale developed by Punniyamoorthy et al. (2013) and Rogers et al. (2016). The items for supply chain exploration and supply chain exploitation practices were amended from scales developed by Dobrzykowski et al. (2015), and Roh and Hong (2015). Supply chain risk management practices were measured by altering the scales developed by Ambulkar et al., (2016), Dubey et al., (2019) and Park et al., (2016). Financial performance was measured by modifying the scale developed by Wamba et al. (2017). The survey adopts a 5-point Likert scale to capture respondent feedback on various constructs ranging from 1 (strongly disagree) to 5 (strongly agree). The starting point for data collection was Lexis-Nexis academic. We used SSIC codes to identify managers from the target

industry and developed a database of 1728 managers. For key informants criteria, the selected survey respondents were senior and middle management professionals globally, who had experience in supply chain management, risk management, and strategy development for their respective organizations (Kumar, Stern, & Anderson, 1993). We then proceeded to contact them, shared with them the topic of our research, and solicited their willingness to participate in our research. To test the quality of the model and ensure reliability and validity of measurement scales, we initially conducted a pilot study with 40 executives from the industry. Johanson & Brooks (2010) have suggested that a sample size of 30 for a pilot study is acceptable. After obtaining adequate respondents from the pilot study, we tested for reliability and validity. The scale exhibited acceptable accuracy as the observed corrected item total correlation (CITC) scores were greater than 0.3, and the Cronbach alpha values higher than 0.7. We also assessed the scores of factor loadings (Hair, Black, Babin, & Anderson, 2010).

Having refined the survey instrument, we proceeded towards final data collection. We uploaded the survey onto Qualtrics, the online survey platform and generated a survey link. All the potential respondents could view this survey link. To ensure a high response rate, continuous communication was maintained with all likely respondents during the data collection time period (Dillman, 2007). Bi-weekly reminder emails were sent to non-respondents informing them of the importance and relevance of the study, followed by a request to participate in the study. Such continuous engagement resulted in us receiving feedback from 328 managers, giving us a response rate of 18.98 percent. To check the distribution of missing responses, Little's MCAR test was applied (Little, 1988) and the analysis showed that values in the database were missing completely at random ($p > 0.05$). This study followed Lin and Wu, (2014) in checking for normality of the data distribution and outliers. Using the currently acceptable methodological

practices (Hair et al., 2010; Li, 2013) responses that had missing data were removed from the final database. Mahalanobis distance was used to check for outliers within the data. The Mahalanobis distance was between 0 and 1 for the majority of the observations indicating that the data conform to normality, and that the data set included only a few outliers (Lin & Wu, 2014). Four observations were identified as outliers, and they were deleted from the database. The final database, after deleting missing variables and outliers, comprised 271 usable responses. The final tests focused on assessing reliability and validity. Each scale (Appendix A) demonstrated acceptable levels of convergent validity and reliability.

The demographic profile of the organizations in the final database is shown in Table 1. An analysis of the database shows a good mix of organizations. Not only are the firms geographically dispersed across four continents, but also represent all the major sub-sectors within the manufacturing and logistics industry. In addition, almost all the firms have been in existence for more than 10 years. This parameter adds strength to the study as managers working in these firms are likely to possess a good knowledge of the type of disruption events, the managing process of such events, and the impact of these disruption incidences on the organization's financial and operational performance. Furthermore, with a good mix of respondents from large and small firms, there is better generalizability of the findings.

(Table 1 Here)

To ensure robustness of the model, we also include firm size as a control variable in our model. We measure firm size by considering two parameters, (1) the number of employees within an organization and (2) the annual turnover of the firm (Saeed, Malhotra, & Abdinnour, 2019). The consideration of these control variables is justified as the circumstances under which supply chain disruption events negatively impact on firm financial performance are contingent

on the size of the firm (Pleshko, Heiens, & Peev, 2014). The inclusion of these control variables in the model helps in extracting the associated variance. As the survey respondents had self-identified the organization that they were working for, secondary data related to the total number of employees and annual revenues of the firm for year ending 2018 were collected through COMPUSTAT and in some cases directly from the company's website. As the data range was extremely broad, we used log values (base 10) for standardizing the values of both variables. In addition to the survey data, such use of secondary data further adds to the robustness of the model and validity of the empirical investigation.

4.3. Data analysis and results

We used AMOS covariance-based structural equation modelling to test our research hypotheses (AMOS 25.0). Scholars have argued that a CB-SEM approach is a superior approach and is better suited when dealing with complex models (Rönkkö, McIntosh, Antonakis, & Edwards, 2016). The complete sample of 271 respondents was used for the estimation. For testing potential response bias, we followed the suggestions of Armstrong and Overton (1977). We compared the findings of early respondents and late respondents. Using the late respondents as a proxy for non-responders, we randomly selected a sub-sample of 50 respondents from the initial contact list and statistically tested for response bias (Choudhary & Sangwan, 2019). The result of the t-test shows no significant difference between early and late respondents, implying that response bias is not a source of concern in our findings.

4.3.1. *Assessing potential common method bias*

To ensure the robustness of the study, detailed tests were conducted to examine potential common method bias (CMB) within the dataset (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). We followed the most widely accepted methodological approaches to deal with common

method bias both ex-ante and ex-post (Chang, Van Witteloostuijn, & Eden, 2010; Hu, Dai, & Salam, 2019; Tourangeau, Rips, Lance, & Rasinski, 2000). First, during the item construction phase we involved two academics and two practitioners well versed in supply chain risk management and strategy development, and used their feedback to refine the survey instrument. Second, during the data collection process, respondents were assured of anonymity and confidentiality of their responses. They were also requested to be as honest as possible and informed that there were no right or wrong answers.

Third, several scholars (Hu et al., 2019; Pavlou, Liang, & Xue, 2007) have suggested that common method bias would exist if the correlations between the constructs were higher than 0.90. In our study, (Table 2), the highest correlation coefficient is 0.60. Harman's single factor test (Podsakoff et al., 2003; Shen, Li, Sun, Chen, & Wang, 2019) also indicates that no single component accounts for most of the variance. Fourth, following the recent approaches on how to improve model robustness and control for CMB (Hu et al., 2019; Malhotra, Kim, & Patil, 2006), we conducted the post hoc marker variable test for the estimation of common method variance. A marker variable was incorporated in the model with a Common Latent Factor (CLF) connector and the variables were imputed to create a new CMB adjusted composites database (Gaskin, 2016). The observed CMB result was 0.0169, which is less than 2 percent. The results suggest that the common method variance is evenly shared across the model and therefore common method bias does not significantly impact the outcomes of the study.

4.3.2. *Measurement model*

The measurement model was evaluated prior to the structural model to ascertain whether we have construct reliability, discriminant validity, convergent validity, and unidimensionality. As factor loadings for almost all items in the scale were found to be above 0.4, all scale items were

used for confirmatory factor analysis (CFA). Unidimensionality was reflected through high internal loadings, high Cronbach's α (CA) which exceeds 0.7 for all constructs (Nunnally, 1978), and high (>0.7) composite reliability for each construct (Hair et al., 2010; Segars, 1997). We also tested the model for multicollinearity using the Variance Inflation Factors (VIF). The range of VIF for the constructs was from 1.15 to 1.88, which is lower than the threshold of 3.33 (Hu et al., 2019). These estimates indicate no multicollinearity exists within the model.

We evaluated the measurement model using CFA (Anderson & Gerbing, 1988). CFA was operationalized in two stages – first through a measurement model, and second through a structural model (James, Mulaik, & Brett, 1982). Values were calculated for composite reliability (CR), average variance extracted (AVE), Cronbach's alpha (α), and item loadings to assess the internal reliability and convergent validity. The standardized CFA loadings in Appendix A provide evidence of convergent validity. Almost all the factor loadings in the measurement model are greater than 0.7, showing convergent validity (Bagozzi et al., 1991). Although three items do have a factor loading below 0.7, Hair et al. (2010) suggest that factor loadings above 0.6 are acceptable if AVE of the construct is greater than 0.5 (Hair et al., 2010). This holds true in our case and therefore the factor loadings of the items below 0.7 were considered acceptable for analysis purposes. To further test convergent validity, we calculate AVE. Table 2 shows that all the constructs meet this criterion. Regarding discriminant validity, the study uses the Fornell-Lacker Criterion, which suggests that the square root of AVE should be greater than the correlation with other latent variables. Table 2 shows that the square roots of AVE (in bold) are higher than the correlation within this construct, satisfying this criterion too.

For an additional test of model fit we used the chi-square goodness of fit test. The chi-square test in our analysis was 1.752, further showing excellent fit (Hair et al., 2010). Another important

index used for assessing model fit is root mean square error of approximation (RMSEA), which provides a mechanism for adjusting for sample size, where chi-square statistics are used (Byrne, 2016). The RMSEA of our measurement model came to 0.053, further providing evidence of a good model fit (Browne & Cudeck, 1992; Byrne, 2016; Kline, 2011). In our measurement model comparative fit index (CFI) was 0.948 showing acceptable model fit (Bentler & Bonett, 1980). Based on these values, we can comprehensively argue that not only does the model exhibit good fit, but it also exhibits high reliability and validity. Since all the measurement criteria were satisfied, we further tested the structural model.

(Table 2 Here)

4.3.3. *Structural model*

We used structural equation modelling to test the hypothesized relationships shown in Figure 1. Covariance-based structural equation modelling was selected as it allows simultaneous testing of direct and indirect effects. In addition, SEM allows the bootstrapping method, which further improves the accuracy of the analysis (Hayes, 2013). The bias-corrected imputed factor scores that were earlier developed to control for CMB, were used in the current analysis. We also used the Durbin-Wu-Hausman test for endogeneity. The standardized path coefficients for the direct relationship are presented in Figure 2. As imputed factor scores were used for the current analysis, fit indices indicators were not adopted to indicate model fit (Gaskin, 2016). The R-squared of the dependent construct firm (Financial Performance) was 0.29. Once the structural model was finalized, we proceeded to test the hypotheses.

5. Analysis of results

The structural model was tested using AMOS covariance-based structural equation modelling to support our hypotheses. The details of the analysis are outlined in Figure 2. Hypothesis 1a

argued that supply chain network risk drivers (SCNRD) negatively impact supply chain exploration (XPLOR) practices. The effect is found to be negative and significant (β= -0.271, p<0.001). Hypothesis H1b further argued that supply chain network risk drivers (SCNRD) negatively impact supply chain exploitation (XPLOY) practices. This impact is also found to be significant and negative (β = - 0.297, p<0.001). Hypothesis H1c on the other hand predicted that SCNRD negatively impact SCRM practices. This hypothesis is not supported as the effect is found to be negative but is insignificant (β = - 0.068, p>0.5).

(Figure 2 Here)

We then tested to evaluate the impact of XPLOR and XPLOY practices on development of SCRM practices. The second hypothesis (H2a) argues that XPLOR positively impacts the development of SCRM practices. This hypothesis is supported, as the effect is observed to be positive and significant (β = 0.227, p<0.001). Hypothesis 2b further argued that XPLOY positively impacts the development of SCRM practices. This hypothesis is found to be true, as the effect is observed to be positive and significant (β = 0.281, p<0.001). The third hypothesis (H3) postulates a negative relationship between SCNRD and FP. This hypothesis is supported as well (β = - 0.312, p<0.001). The final hypothesis (H4) tested for the positive relationship between SCRM practices and FP. This hypothesis is strongly supported (β = 0.573, p<0.001). Firm size as a control variable was measured through number of employees (β = 0.152, p<0.001) and annual revenue of the firm surveyed (β = - 0.120, p<0.001). Both the control variables show a high level of statistical significance indicating that they play an important role in controlling for firm size within the analysis. The empirical analysis of the hypothesized relationships therefore exhibits that in the case of hypothesis H1a and H1b, relationships were found to be

negative and statistically significant. Hypothesis H1c was however not supported. All the other hypothesized relationships (H2a, H2b, H3 and H4) were supported.

6. Discussion of the findings

The research aimed at examining how supply chain exploration and exploitation practices mitigate the negative impact of supply network risk drivers on firm financial performance. In this section, we report several key points for further discussion. First, we observe that network risk drivers are negatively related to supply chain exploratory (H1a) and supply chain exploitative practices (H1b). This observation is in keeping with the literature as supply chain disruptions (e.g., supplier failure, weak quality practices and inefficient delivery mechanisms) increase managerial uncertainty. Therefore supply chain exploration activities tend to focus narrowly on the specific disruptions-related information requirements rather than expand to broadly proactive information activities (Alikhani et al., 2019; Gold & Schleper, 2017). In a similar fashion, supply chain disruptions tend to have a negative impact on organizational responsiveness in terms of operational efficiency and risk resilience to address immediate competitive requirements (Quang & Hara, 2018).

Second, supply chain network risk drivers are observed to be not directly related to risk management practices (H1c). This is surprising, but is primarily due to the manner in which SCNRD impacts SCRM practices. SCNRD are defined as being explicit and routine forms of risk drivers (e.g., supplier failures, quality errors, delivery delay). Thus, SCNRD are more associated with operational business practices rather than supply chain risk management practices (Walker, Seuring, Sarkis, & Klassen, 2014; Yoon et al., 2018). Therefore the impact of SCNRD on SCRM is indirect and has to be interceded through another variable. This result further adds to our understanding of how organizational strategy develops in response to external

risk drivers. We therefore contend that the development of strategic practices has to be a well thought out process that includes all stakeholders within an organization. In addition, it should result in emergence of specific prescriptions to manage the challenges being faced by an organization. Such a process of strategy development should include intra- and inter-organization information-sharing (Riabacke, 2006). Therefore SCRM practices are not a direct result of network risk drivers, but a process in which organizations understand their operating environment and respond accordingly.

Third, supply chain exploratory practices (H2a) and supply chain exploitative practices (H2b) are observed to be positively related to supply chain risk management practices. The results provide support for both H2a and H2b, suggesting that they positively impact the process of supply chain strategy development under conditions of risk. These findings indicate that risk management practices are not developed in direct response to business risk drivers, but through a symbiotic relationship between exploration and exploitation practices. Second, we observe that organizations are able to develop successful risk mitigation practices, if firm management adopts a policy of wait and watch, instead of impulsively acting on a response mechanism to the supply chain disruption event. This result further points to an increasing importance of supply chain exploration and exploitation practices in reducing the negative impact of supply chain disruption events. Therefore, organizations can handle supply chain disruption better if they use the decision-making process of assimilation, identification and processing of information.

(Table 3 Here)

Fourth, network risk drivers are found to be negatively related to firm financial performance (H3). This confirms several previous research findings that had argued a similar relationship (Gualandris et al., 2018; Hendricks & Singhal, 2005; Shi & Yu, 2013). Network supply chain

disruptions (e.g., Sony's 2004 PlayStation failures, 2007 Mattel's recalls, 2018 Toyota recalls) are extremely traumatic events for firms as they reduce organizational ability to honor their business commitments. As a result firms face revenue loss, reduced brand value and erosion of customer loyalty (Chakravarty, 2013). Fifth, we observe that supply chain risk management practices have a positive impact on firm financial performance (H4). This finding suggests that although network risk drivers do negatively impact firm financial performance, risk management practices with a combination of exploration and exploitation practices are likely to manage the adverse impact of supply chain disruption events. They further enable the organization to achieve positive financial outcomes. This is an important discovery as supply chain risk management practices are different from internal operational practices; in fact, they are inter-organizational preventive and proactive practices. It can therefore be argued that strategic practices that emerge as a consequence of a symbiotic relationship between exploration and exploitation practices will enable firms to develop managerial capacity to manage current and future disruption events. These findings further enhance our understanding of how supply chain risk management practices can empower firms, enabling them to manage business disruption events and achieve positive financial outcomes.

7. Conclusion: Implications and limitations

The purpose of the research was to examine how organizations develop risk management practices to mitigate the negative impact of supply chain disruption events. We presented a research model that defines key variables based on the strategic decision-making and risk management literature, and developed an empirical study to test our hypotheses. The analysis of the results provides a significant understanding of the hypothesized relationships and therefore offers several theoretical and managerial implications.

7.1. Theoretical contribution

The research adds to our theoretical understanding of the topic at several levels, especially since the research measures (risk drivers, exploration/exploitation practices, and risk management practices) have been collected from an international response base. First, the inverse relationship between network risks and exploration/exploitation practices suggests the significant role of prudent responses, rather than hyper-activities in dealing with network risks. From a network theory perspective, network effectiveness is not measured by the volume of activities but the quality of engagement (Håkansson & Snehota, 2006; Zain & Ng, 2006). Our analysis highlights that, when risk factors increase, firms do not multiply their risk mitigation activities. Instead they focus on the quality of relationships and target more specific actionable decisions. Before firms come up with strategic decisions, they engage in quality decision-making activities to explore options (i.e. supply chain exploration and exploitation practices) and then determine implementable choices (i.e. supply chain risk management practices). These strategic practices are crucial in making effective business decisions.

Second, the results provide theoretical insight into the role of exploration and exploitation practices in development of supply chain risk management practices. Recent works have suggested additional investigation of 'the balance of exploration and exploitation' and 'learning and memory orientations' for 'organizational and supply network' decision-making processes (Gualandris et al., 2018; Lennerts et al., 2020; Ojha et al., 2018). This study therefore affirms the integrative need of learning-oriented supply chain exploration practices, and results-driven exploitation practices, on risk management practices within the supply chain domain.

Third, the negative relationship between risk drivers and financial performance and the direct relationship between network risk management practices and financial performance indicate that

clearly defining network risk drivers is important to mitigate their negative impact on financial performance, whereas supply chain risk management practices deserve adequate resource allocation in view of their obvious positive impact on financial performance. Therefore, our research findings complement the growing body of SCRM scholarly works that suggest the financial benefits accruing to an organization from managing risks within their supply chain network (Blos, Hoeflich, Dias, & Wee, 2015; Wang, Tiwari, & Chen, 2017).

7.2. Managerial implication

This research also has several managerial implications. First, organizations have to focus on developing risk management practices to mitigate the disruptive impact of risk drivers. The results imply that there is a strong and direct impact of risk management practices on firm financial performance. This finding is important as, "surveys have shown that while managers appreciate the impact of supply chain disruptions, they have done very little to prevent such incidents or mitigate their impacts" (Chopra & Sodhi, 2014:73). The primary reason being that they always weigh the cost of these solutions in comparison to the financial benefits of adopting such strategies (Chopra & Sodhi, 2014). The results also highlight that in the absence of supply chain risk management practices, firms suffer from financial loss. Furthermore, given that we control for organization size in the analysis, it can be argued that supply chain disruption incidents negatively impact both big and small organizations in terms of financial outcomes.

Second, we report that network risk drivers are negatively related to strategic decision practices (i.e., exploration and exploitation practices). Complex network risk drivers are relational and dynamic. Therefore, managing network supply chain risk drivers would require developing strategic responses from a planning and a responding perspective. A greater level of network risk drivers does not necessarily translate into firms developing several risk

management practices. Instead firms step back and watch how these network risk drivers unfold, identify the visible and definite forms of risk factors, and then take corrective actions. In this sense, firms usually adopt a more measured approach in regard to routine supply chain network risk drivers.

Third, the analysis demonstrates that an organization's experience of managing past supply chain network risks does not necessarily determine the effectiveness of supply chain risk management practices. SCRM practices do not merely dwell on previous experiences of various suppliers' failures. Rather, outstanding organizations focus on learning from failures and improving organizational processes for risk prevention in the future, and better responsiveness performance in the present. The key lies not in remembering past failure incidents, but in achieving innovative learning from examining the reasons for failure (i.e., supply chain exploration practices), and implementing follow-up with routine actions (i.e., supply chain exploitation practices). As risk factors are clearly identified, realistic response mechanisms can be designed by middle and senior management through a symbiotic process between exploration and exploitation practices. Finally, the study provides valuable lessons for firms to manage disruptions within their supply chain networks. These risk management strategies include initiatives such as (1) involving suppliers in developing network wide risk management initiatives, (2) developing an organizational focus on monitoring the pattern of supply chain disruption events, (3) working with suppliers to improve their quality and productivity parameters, and (4) extending lean management initiatives across the extended supply chain network. These strategies were empirically validated as being relevant across the manufacturing and logistics sectors, and therefore our research findings are useful to firms for responding better to future supply chain disruption events.

7.3. Limitations and future research direction

As with all empirical research, our study too has certain limitations. First, most respondents were managers working in either the manufacturing sector or the logistics sector. However, this research does not include service firms such as Amazon, Alibaba, Walmart, Flipkart and so on. Therefore our research findings may not be directly relevant to the service sector context. Another limitation of the study is in terms of identifying specific sector-wide practices that firms can develop to mitigate supply chain risk. This study was primarily empirical in nature and therefore aimed at quantitatively identifying strategic practices that are relevant to both the manufacturing and logistics sectors. As the sub-sector responses were not sufficient in number, a detailed empirical analysis of sector-specific supply chain risk management practices was not feasible. Therefore, future studies will conduct an in-depth case study of additional firms. Such an approach will examine how the risk drivers vary across sub-sectors, as well as determine strategies that are most effective in mitigation of these disruption risks.

7.4. Conclusion

The study attempted to examine how firms develop risk management practices to mitigate the potential negative impact of disruptions in their supply chain network. The research model presents relevant variables that practitioners find useful and meaningful for manufacturing firms. Furthermore, the survey instruments used in this research have been empirically validated and show high levels of reliability and validity. Thus, this instrument might be used as a benchmark tool for assessing risk management practices of other firms and their network participants. The study also adopts a quantitative methodology to explore the relationships between drivers, strategic practices, and financial outcomes, in the form of hypotheses. The research findings report that increasingly, organizational risk by nature is network-related and not firm-specific.

Furthermore, external risk drivers are not directly manageable. Rather, strategic priority is to formulate supply chain exploration practices for discovery learning from examining supply chain failures. At the same time, an operational focus is to implement supply chain exploitation practices for delivery learning for designing risk management practices. This study highlights that in a dynamic, interactive and integrative world of business, network risk challenges require prudent senior management attention to develop and utilize internal and network information capabilities and then connect them to risk management practices.

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Appendix A: Survey Instrument

Variables	Item Descriptions (Scale)	Mean	S.D.	Loadings
Supply Chain Network Risk Drivers (α = 0.789)				
SCNRD1	Our suppliers' weak quality practices damage productivity goals.	2.88	.888	.723
SCNRD2	Our suppliers' delivery performance often generates complaints from our customers.	2.67	.890	.729
SCNRD3	Our suppliers' capabilities are inadequate to meet fluctuating customer orders.	2.68	.837	.787
Supply Chain Exploration Practices (α = 0.831)				
XPLOR1	Our managers find new supply chain ideas from a diverse set of people (e.g. from different firms, industries etc.).	3.28	.837	.700
XPLOR2	Our managers identify supply chain improvement opportunities through industry conferences.	3.00	.909	.731
XPLOR3	Our managers seek emerging supply chain trends through environmental scanning practices.	3.06	.828	.812
XPLOR4	Our managers explore innovative supply chain solutions thorough good listening practices.	3.42	.779	.743
Supply Chain Exploitation Practices (α = 0.903)				
XPLOY1	Our managers respond to changing supply chain conditions.	3.68	.805	.815
XPLOY2	Our managers complete important projects together.	3.52	.847	.779
XPLOY3	Our managers execute strategic supply chain priorities for effective results.	3.61	.887	.825
XPLOY4	Our managers choose the best possible course of supply chain action among the available options.	3.48	.764	.796
XPLOY5	Our managers build on the mid-term results for final excellent supply chain outcomes.	3.53	.792	.793
XPLOY6	Our managers excel at accomplishing their functional level supply chain goals.	3.49	.856	.700
Supply Chain Risk Management Practices (α = 0.796)				
SCRM1	Our firm involves suppliers for strategic risk management initiatives	3.27	.984	.715
SCRM2	Our firm monitors patterns of supply chain disruptions.	3.41	.999	.854
SCRM3	Our firm achieves performance improvement goals of suppliers (e.g., quality and delivery productivity targets).	3.65	.878	.697
SCRM4	Our firm implements lean management in the extended supply base.	3.25	1.087	.707
Firm Financial Performance (α = 0.859)				
FP1	Within the last three years, our firm has achieved profitability growth targets.	3.75	.986	.790
FP2	Within the last three years, our firm has increased competitive market share.	3.32	1.038	.762
FP3	Within the last three years, our firm has reported steady sales growth.	3.41	1.118	.796
FP4	Within the last three years, our firm has secured desirable return on asset (ROA) performance.	3.49	.886	.698
FP5	Within the last three years, our firm has ensured steady cash flows.	3.91	.935	.696

Tables

Table 1: Profile of firms in the database by Industry, Firm Size and Location

Dimension	Category	Frequency	Percentage (%)
Industry	Chemical Manufacturing	6	2
	Pharmaceuticals	11	4
	Healthcare Manufacturing	11	4
	Automotive Manufacturing	11	4
	Technology Manufacturing	19	7
	Food Manufacturing	28	10
	Service	39	14
	Logistics	48	18
	General Manufacturing	98	37
Company Size (Number of Employees)	>1000	105	38
	500 – 1000	83	31
	100 – 500	61	24
	1 – 100	22	8
Duration Company has been in Operations	>10 Years	271	100
Geographic Location	North America	127	47
	Europe	61	23
	Asia	58	21
	South America	25	9

Table 2: Reliability and Variance of Constructs

Constructs	CR	AVE	Network Risk Drivers	Supply Chain Exploration Practices	Supply Chain Exploitation Practices	Supply Chain Risk Mgmt. Practices	Firm Financial Performance
Network Risk Drivers	0.791	0.558	**0.747**				
Supply Chain Exploration Practices	0.835	0.559	-0.143	**0.748**			
Supply Chain Exploitation Practices	0.906	0.617	-0.185	0.603	**0.786**		
Supply Chain Risk Mgmt. Practices	0.833	0.557	-0.124	0.415	0.445	**0.746**	
Firm Financial Performance	0.865	0.562	-0.197	0.352	0.424	0.427	**0.750**

CR = Composite Reliability; AVE = Average Variance Extracted

Table 3: Structural Estimates (H1 – H4)

Hypothesis	β	Result
H1a	- 0.271	Supported
H1b	- 0.297	Supported
H1c	- 0.068	Not Supported
H2a	0.227	Supported
H2b	0.281	Supported
H3	-0.312	Supported
H4	0.573	Supported

Figures

Figure 1: Research Model

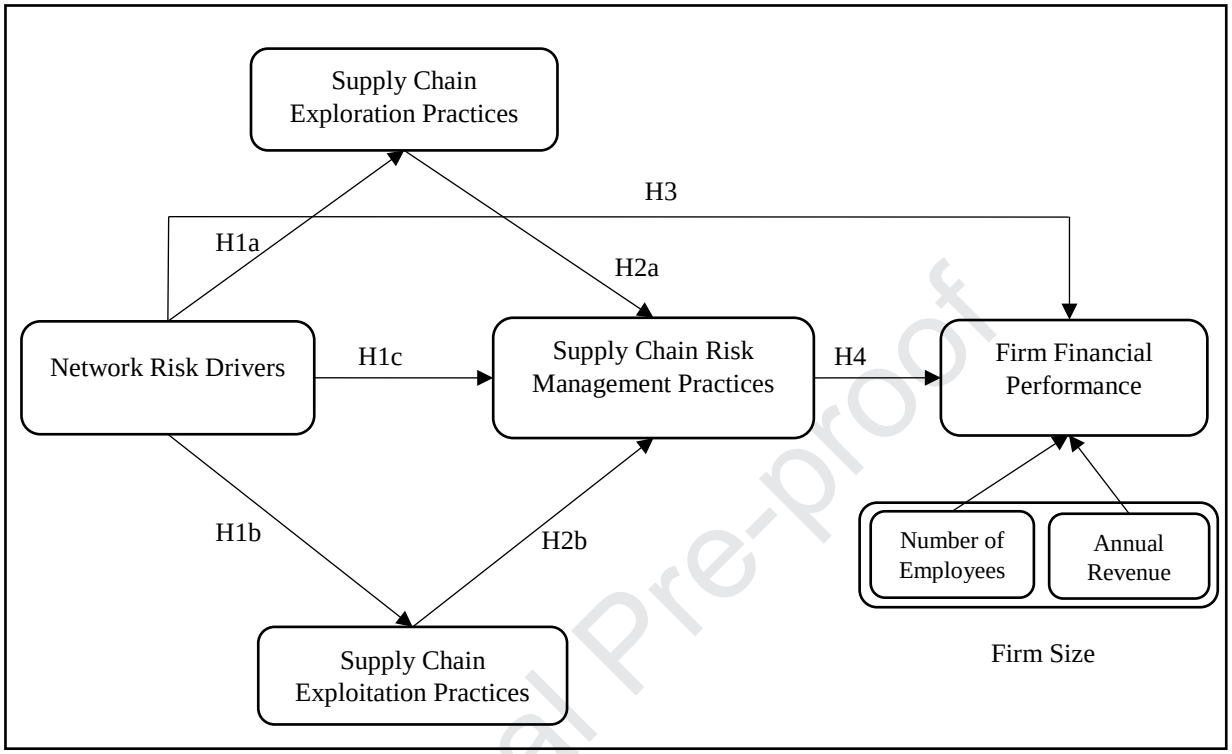
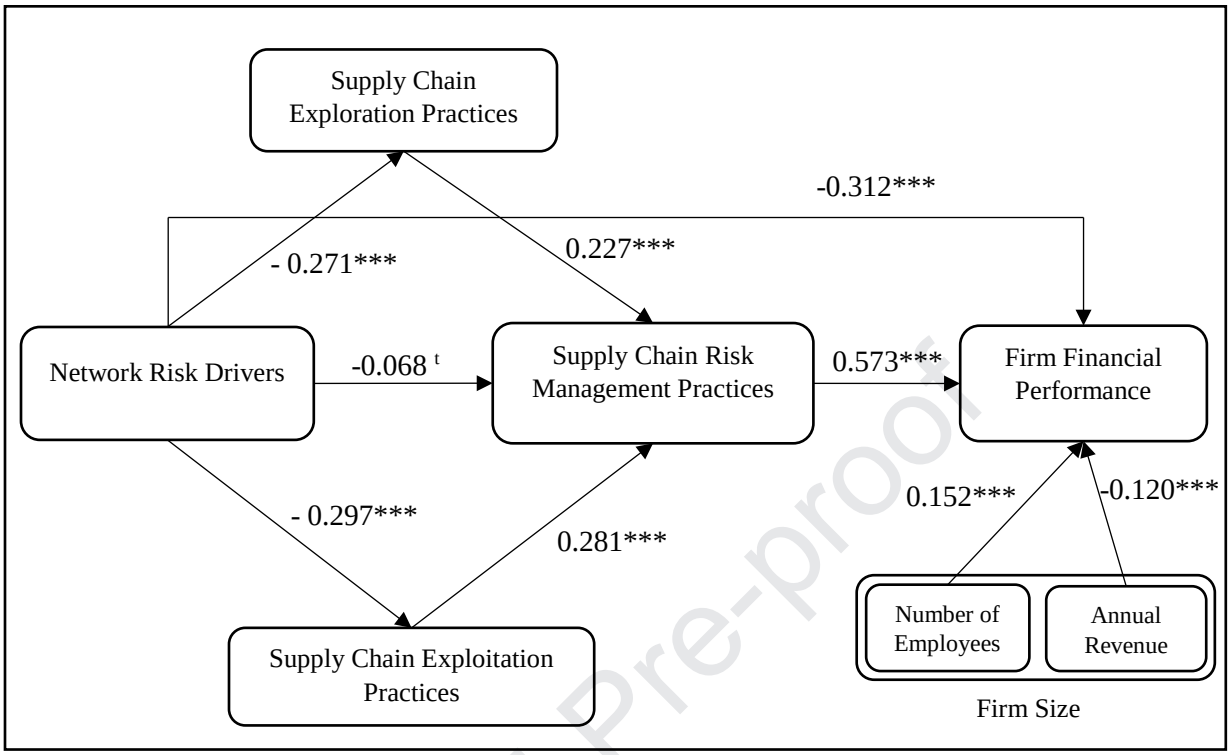


Figure 2: Research Model – Analysis of Results



***: $p < .001$; $^{t}p > .05$

Highlights

- Firms with global supply chain networks face disruption risks leading to financial loss.
- Supply chain disruption events negatively impact strategic decision-making.
- Strategic decisions developed through risk analysis are effective in risk mitigation.
- Such decisions lead to development of effective risk management practices.
- Risk management practices enable organizations to achieve positive financial outcomes.