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Supply Chain Resilience Research: Theory and Influence Mechanism

LIU MIN
Azman Hashim International Business School, Universiti Teknologi Malaysia
liuminjingdezhen@gmail.com

THOO AI CHIN*
Azman Hashim International Business School, Universiti Teknologi Malaysia
acthoo@utm.my

**Corresponding Author*

ABSTRACT

Supply chain resilience is regarded as the ability of manufacturing organizations to maintain a high degree of environmental awareness and quickly reply and adapt after a disruption occurs. Supply chain resilience can ensure the complete structure and function of the supply chain system to the greatest extent while ensuring the continuity of information flow and logistics. The academic circles pay increasing attention to the research of supply chain resilience. However, the existing research mainly focuses on case analysis and phenomenon description, and the research conclusion lacks a theoretical and empirical basis. Hence, the present study uses the systematic review method to sort out the literature and analyses supply chain resilience research theory. Then, the development research background of supply chain resilience is discussed. This study will provide a theoretical framework and a basis for future empirical research and provide theoretical guidance for companies to build a resilient supply chain.

Keywords: supply chain resilience; research theory foundation; literature review.

INTRODUCTION

With the deepening of economic globalization and regional economic integration, the breadth and depth of manufacturing companies' participation in the global supply chain system have gradually increased. Nevertheless, supply chain management is facing an increasingly complex, dynamic, and uncertain operating environment. This event is caused by trade protectionism, the rapid development of new technologies, and the diversification and personalized changes of customer needs. While entering the global supply chain system, manufacturing companies face supply chain security risks. Natural disasters, supply, and demand disruptions caused by upstream and downstream companies in the supply chain also face such risks. The present study found that risk and disruption in the supply chain led to a loss of up to 40% of the company's market value. Moreover, operating income decreased by 107%, sales fell 114%, and return on assets down 92%. Companies that have suffered a supply chain break take an average of two years to recover fully. The COVID-19 epidemic, which broke out at the end of 2019, is a landmark global risk event (Dan, 2021). The outbreak in China has not only disrupted the operations of Chinese companies but has also threatened the normal operation of global supply chains. Apple expects that the production of mobile phones in the first quarter will be reduced by 5%-10% due to the suspension of work by upstream suppliers in China. Automotive industry research and forecast company predict that China's auto production will reduce by 800,000 units in 2020. The World Bank estimates that the world will lose 5% of GDP or approximately 3 trillion US dollars because of the supply chain disruption caused by the COVID-19 pandemic.

Therefore, manufacturing companies should actively face the opportunities and challenges in supply chain risks and improve supply chain resilience. They should also effectively handle supply chain disruptions, gain competitive advantages in a dynamic and changeable business environment, and improve the global supply chain system status. Previous studies believed that supply chain resilience could tackle supply chain risks, enabling the supply chain to maintain high environmental vigilance and quickly respond to disruptions. Meanwhile, this ability to adapt ensures the integrity of the supply chain while balancing logistics and information flow continuity. Although the area of supply chain resilience of supply chain management has received increasing attention from scholars, few studies can accurately and comprehensively describe supply chain resilience from a theoretical view. Previous studies also lack on the antecedents and effects of supply chain resilience.

This study conducts a systematic literature review in the supply chain field. The study also combs in detail the theories used in the research of supply chain resilience, including the research development context of the antecedents and results of supply chain resilience. This study not only provides a basis for future research but also further expands related theoretical research, providing a theoretical basis for manufacturing companies to build a resilient supply chain net. In addition, this study provides valuable guidance for the safe operation of supply chain systems.

SUPPLY CHAIN RESILIENCE THEORY FOUNDATION

Resource-based view theory believes that valuable, rare, inimitable, and irreplaceable resources can bring a competitive advantage to organizations (Barney, 2001). Barney et al. (2011) further noted that capabilities such as management skills, processes, and practices also have value, rarity, hard to imitate, and irreplaceable characteristics and can be regarded as vital assets that can bring organizations a competitive advantage. Based on this theory, Hazen et al. (2012) believed that, as an essential resource, logistics information technology improves the speed and efficiency of product delivery, thereby enhancing supply chain resilience. Cheng et al. (2017) regarded supply chain operation strategies and processes, adaptable practices, and absorptive capacity as resources that can improve supply chain resilience. They considered supply and demand management, supply chain cooperation, visualization, response speed, flexibility, and highly integrated resources. Logistics is a resource that enhances supply chain resilience. Gabler et al. (2017) noted that good relationships are the resources to build supply chain resilience. Moreover, some scholars believed that visualization is an essential resource that can play a vital role in protecting performance during supply chain risks. Particularly, supply chain systems have become more complex nowadays Brandon-Jones et al. (2014). In addition, Birkie et al. (2017) took the resource-based view as the theoretical background. They discussed supply chain resilience as an irreplaceable resource for companies to improve performance when the supply chain is disruption. The promotion effect is more prominent.

From another aspect, dynamic capability theory believes that companies need to identify opportunities and threats, build, integrate, and reconstruct internal and external resources, and deal with the dynamics of the environment, to gain a competitive advantage in an environment full of uncertainties (Teece, 2007). Eisenhardt et al. (2000) stated that dynamic capabilities are embedded in organizational practices, and companies with high dynamic capabilities can evolve with their environment to obtain and maintain continuous competitiveness. Barreto (2010) divided dynamic capabilities into four stages: sensing opportunities and threats, timely response, deciding market-oriented decisions, and changing the source structure to adapt to changes. Many studies explored the resilience of the supply chain and its forming mechanism based on the theory of dynamic capabilities (Brusset et al., 2017; Li et al., 2017). For example, Gabler et al. (2017) regarded short-term cooperation between enterprises and the government

in the case of natural disasters as a dynamic capability. They believed that this capability can improve supply chain resilience. Lee et al. (2016) demonstrated that environmental awareness, rapid response, resource, and capability reconstruction are also a process for improving resilience. Research increasingly regarded supply chain resilience from the dynamic energy perspective. For instance, Chowdhury et al. (2017) found that supply chain resilience can be recognized as a dynamic ability to handle uncertain events and risks effectively. They identified the active and passive capacity in the resilience dimension and developed a theory based on dynamic capabilities measurement standards. Dabhilkar et al. (2016) stated that the resilience from the supply-side part is a dynamic capability, which can be embodied as a series of activities for enterprises to resume operations from supply interruptions. Eltantawy (2016) believed that supply chain flexibility is a dynamic capability. First, supply chain flexibility represents the capacity of an enterprise to maintain efficiency and performance consistency after a supply chain break occurs. From another aspect, supply chain flexibility represents the ability of an enterprise to make changes to respond to unknown environments. Li et al. (2017) looked at the supply chain resilience from three unique dynamic functional perspectives, namely, preparedness, agility, and alertness. They also confirmed interrelationships among these capabilities and corporate performance in finance. Brusset et al. (2017) stated that the construction of supply chain resilience requires relatively low-level operational capabilities, such as the ability to integrate internal processes and information flows and cooperate with external suppliers and customers coordination ability. The relationship among supply chain flexibility and operations, relationships, finance, and supply chain performance is from a dynamic capability perspective (Mandal (2017a).

MECHANISM OF SUPPLY CHAIN RESILIENCE

ANTECEDENT OF SUPPLY CHAIN RESILIENCE

Previous studies mainly discussed the research dimensions and effects of supply chain resilience from the perspective of resources and capabilities. The resources for enhancing supply chain resilience mainly refer to those redundant resources that play a shield role in the supply chain disruption. When disruption or unexpected events occur, a particular resource cannot perform its function. However, other reserved resources can play a substitute role and quickly make up for the failure of the resource. These resources include excess inventory or backup production capacity, diversification strategies (product and customer diversification), multi-point storage and transportation route backup, product diversity and substitutability, procurement backup, multi-source procurement, the preparation time and capital reserves for supply chain rupture, and emergency plan for supply chain rupture (long- and short-term plans) (Khalili et al., 2017; Ponomarov et al., 2009).

In addition to these redundant resources, previous studies also explored other resources on the resilience of the supply chain. This article divides these resources into two types: internal and external resources. Enterprise internal resources include human resources, technical resources, and organizational resources, whereas external resources include technological resources, collaboration resources, and relational resources.

First, companies need to increase human resource investment and improve human resource management. After emergency events, such as supply chain breaks, companies can rely on high-quality employees to better respond and recover (Tukamuhabwa et al., 2017). Blackhurst et al. (2011) believed that carrying out employee emergency management-related education and training and knowledge management, establishing a performance feedback mechanism, and building a cross-departmental risk management team are necessary conditions for establishing supply chain resilience. Jaaron et al. (2014) found that employees with high

emotional commitment will participate more actively in restoring supply chain operations. Moreover, Datta (2017) noted that team management increases organizational flexibility and improves supply chain resilience. In addition to increasing investment in human resources for employees, high-level leadership and determination are also keys to improving supply chain resilience (Demmer et al., 2011).

Former research suggested that companies can also rely on technological resources for enhancing resilience. Some scholars believed that applying advanced information technology can enhance the recovery speed during a disruption situation, and visualization tools reduce the difficulty of information processing (Lam et al., 2016; Sullivan-Taylor et al., 2011). Pereira et al. (2014) stated that resilience can be increased by unitizing manufacturing technology that improves production flexibility, and companies can also modularly produce goods to make up for the shortage of a particular product during disruption.

In addition, companies can use organizational resources to improve supply chain flexibility. For example, the risk management strategy and innovation culture not only increase the alertness of enterprises to supply chain risk but also help enterprises recover more effectively through innovative operation processes after supply chain breaks occur (Christopher et al., 2004; Mandal, 2017b). Jüttner et al. (2011) found that enterprises with sufficient knowledge of risk management have a higher resilient capability. Moreover, Ponomarov et al. (2009) believed that a flexible organizational structure is necessary for building resilience capacity. Tenhiälä et al. (2014) argued enterprises' operating practices to deal with uncertainties are essential for effective supply chain recovery.

External resources refer to resources that cross enterprise boundaries and connect supply chain partners to act as a link. They mainly include technical resources, cooperation resources, and relationship resources between organizations. First, companies need to establish rapid response information systems across enterprise boundaries to stay in touch with suppliers and customers, to achieve rapid information sharing through standardized information formats, and to easily process information in the supply chain for responding quickly to disruptions (Jain et al., 2017). From another aspect, companies must participate in risk-sharing mechanisms with suppliers and customer groups to protect against risks, and more flexible design contracts also allow companies to maintain sufficient flexibility in supply chain contingencies (Carvalho et al., 2011). According to previous research, establishing strong social capital between the company and the essential partners significantly improves the supply chain resilience (Ali et al., 2017). Companies can tackle supply chain risks by actively implementing supply chain recovery activities by taking effective countermeasures from external resources (Datta, 2017; Gabler et al., 2017; Jain et al., 2017).

From the point of capability (operational activities), the influencing factors of supply chain resilience include remarkable capabilities directly related to supplying chain rupture and general capabilities embedded in daily operational activities. The ability to specifically respond to supply chain ruptures and improve supply chain flexibility includes alertness to supply chain disruption, rapid response to risk or disruption, and the capacity to integrate resources and process reconstruction after supply chain ruptures (Carvalho et al., 2011). Some scholars believed that enterprises should build a flexible and agile supply chain to improve the capacity to rapidly handle environmental uncertainty (Brandon-Jones et al., 2014; Tukamuhabwa et al., 2015). Among them, flexibility is particularly important. For example, Ishfaq (2012) noted that companies should maintain the flexibility of product transportation and distribution design corresponding to distribution lines for different needs. Kamalahmadi et al. (2016) believed that the flexibility and reliability of suppliers are the key element to building the supply chain resilience, which avoids the disruption caused by the shortage of raw materials.

Some studies found that the capacity of visibility in the supply chain from information technology can improve supply chain resilience. Visualization enables companies to track the

production and distribution of products from fresh materials to finished products in real time. Visualization can also enhance their information processing capabilities and minimize the impact of uncertainty. Therefore, supply chain visualization not only helps companies identify potential supply chain rupture risks but also helps related companies quickly process information to achieve effective recovery when the supply chain is ruptured (Brandon-Jones et al., 2014; Mandal et al., 2016). Mandal (2017c) and Carvalho et al. (2011) found that the visualization of supply and demand helps companies accurately identify upstream and downstream changes and implement targeted countermeasures based on changes to achieve rapid and effective recovery. Brusset et al. (2017) noted that the increased level of cooperation and integration between enterprises can also improve supply chain resilience. Specifically, Mandal et al. (2017) believed that information system integration and logistic systems, information sharing, formal and informal communication, process coordination, and others promote the collaborative response of enterprises in the supply chain to uncertainty. Lam et al. (2016) suggested that companies should enhance their supply chain relationship management capabilities and form strategic alliances with upstream and downstream companies to enhance the resilient capability of improving market forecasting and risk assessment capabilities. Some scholars also believed that a learning-based supply chain should be established, such as adequate knowledge sharing and deep learning between enterprises, including new product development involving suppliers and customers to enhance the innovation capabilities of products and processes. Companies can use diversified products and services, flexible and innovative processes, and structures to deal with supply chain breaks (Kristianto et al., 2017).

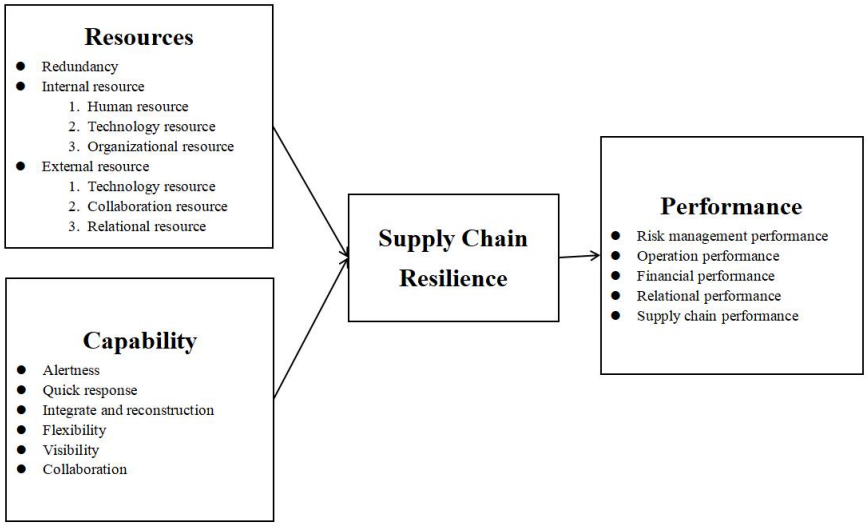
RESULTS OF SUPPLY CHAIN RESILIENCE

Supply chain resilience not only helps companies recover from disruption and risk but is also an essential source of core competitiveness. Precisely, resilience can improve the supply chain performance outcome directly related to supply chain risk management strategies (Zsidisin et al., 2010), reducing fragility (Singh et al., 2019), the time and economic cost of supply chain recovery from disruption (Datta, 2017), the operational risks of enterprises (Tukamuhabwa et al., 2017), and the effect of disruption or risk on business performance (Jüttner et al., 2011).

Moreover, the resilience of the supply chain can bring sustainable competitive advantages (Azevedo et al., 2013; de Oliveira Teixeira et al., 2013). Previous studies initially verified that supply chain resilience can bring improvements in operational and financial performance (Bhattacharya et al., 2013). In addition to the resilient supply chain network, companies can reduce the out-of-stock rate and recover from uncertain events more quickly and effectively. Hence, companies with resilient supply chains gain a higher customer value and market share than their competitors (Hohenstein et al., 2015b; Wieland et al., 2013). Similarly, Pettit et al. (2010) and Hohenstein et al. (2015a) stated that supply chain resilience not only improves core enterprises' performance but also ensures the availability of goods and meet customer needs and satisfaction in the supply chain. Mandal (2017a) believed that companies improve the performance of relationships between supply chain partners by increasing trust and dependency in supply chain partnerships by constantly collaborating with each other to face risks and disruptions.

Based on the above discussion of the literature, the present study further summarizes research on the supply chain resilience field, as shown in Figure 1.

FIGURE 1. Summary of research on supply chain resilience



In general, the concept of supply chain flexibility is quite broad and rich. The construction of a resilient supply chain requires enterprises and their supply chain partners to participate and invest corresponding resources. This construction also needs relevant enterprises to have certain risk management practices and the capability to collaborate. In addition, supply chain resilience is an effective method to tackle supply chain risk and bring performance improvements.

CONCLUSION

Through systematic combing and review of the literature on supply chain elasticity, this study found that few studies can systematically provide a research framework for supply chain elasticity based on theory and the adaptation problem in supply chain resilience research through data verification theory. This study further reveals the connotation and formation mechanism of supply chain elasticity through two theories. Moreover, according to the resources and capabilities, companies need to build supply chain resilience to divide the dimensions, such as redundant resources, strategic inventory, risk management culture, flexibility, agility, visualization, and learning ability. These resources and capabilities are a pre-factor variable of supply chain resilience to further study the supply chain causes and results. This study provides a detailed reference and corresponding research framework for future scholars and professionals to conduct supply chain elasticity research.

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ABOUT THE AUTHORS

Liu Min (1991) is a Master student in Universiti Teknologi Malaysia (UTM). He currently works as a research assistant and mostly engaged in research on supply chain management.

Thoo Ai Chin (1981) obtained her PhD in Supply Chain Management from Universiti Teknologi Malaysia (UTM). She is a senior lecturer and Head of Program for Bachelor of Management (Marketing) in Azman Hashim International Business School, UTM. Her research interests include supply chain management, logistics, marketing, and customer relationship management.