



The Application of Enterprise Risk Management Concept in Building Supply Chain Resilience in the United States' Manufacturing Sector

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Abstract

This paper joins the discourse on the critical role that supply chain management plays in both national and international manufacturing and development. While there is a general campaign for globalization, open economy vis-à-vis their numerous benefits, companies, local and international, have reported the risks associated with supply chain disruptions and how such negatively manufacturing operations and distribution of goods. This study adopted a qualitative research design, and a conceptual framework to examine the role of enterprise risk management in mitigating supply chain disruptions. The study identified some challenges that may impede the successful deployment of the Enterprise Risk Management (ERM) in supply chain risk management (SCRM) in the United States, and also provided some recommendations towards a successful deployment.

Keywords: Supply Chain Management, Enterprise Risk Management, Upstream SCM, Downstream SCM, Risk Mitigation, United States.

I. INTRODUCTION

Supply chain management, which “represents a framework for connecting important points in a business network and delivering items that will facilitate production, distribution and consumption” (Akanbi, Hinmikaiye, & Adeyemi, 2024 p750), has become a veritable tool for enhancing efficiency and effectiveness of a business concern. Although, supply chain practice is primarily associated with industrial logistics and movement of materials, people, equipment and products between critical nodes of an organization, it has also become a useful tool in other sectors of the economy including healthcare (Clauson, Breeden, Davidson, & Mackey, 2018), food,

services industry and retail (Turi, Goncalves, & Mocan, 2014; Ivanov, Das & Choi, 2018; Wen, Choin, & Chung, 2019; Shishehgharkhaneh, Moehler, Fang, Aboutorab, & Hijazi, 2024). However, the usefulness of supply chain management has been undermined by the exposure of companies to supply chain disruptions related risks.

Over the years, the supply chain disruption risks and their impact on firms' performance (operations and profits) have been largely reported by companies' executives (Sodhi, Son, & Tang, 2011). Interestingly, the risks associated with distribution and recalling of products from different parts of the world, such as delayed shipment, cancellation of orders, the incidence of natural and man-made disasters, supplier solvency, and Covid-19, among others, have birthed the need for building a strong resilience in supply chain operations by companies in their pursuit of efficiency and effectiveness. Supply chain disruption is a costly shock to enterprise's operation. Unfortunately, the cost of such disruptions to the world (people and businesses) has received little attention.

The impact continues to negatively affect individual businesses. In 2011, for instance, the Tuhoko's tsunami in Japan cost Toyota's output to decline by 40,000 vehicles, while about \$72 million was lost in daily profits (Pettit, Croxton, and Fiksel 2013). Similarly, a fire incident that destroyed Phillip's semiconductor plant in 2000 affected Ericsson to the tune of \$400 million loss, while filing an end of year loss to the tune of \$2.34 billion for the company's mobile phone section (Sodhi *et al* 2011). Companies, big and small, have lost fortunes to unexpected disruptions in their supply chain networks. Although, there has been no singular estimate of the total loss of revenues and operational costs to all companies as a result of supply chain disruptions, the effects of such disruptions on individual companies range between short-term



and long-term periods, and could sometimes mean an end to the affected organizations' existence.

Supply chain disruptions by risk exposures usually take many forms. In fact, the diversity of the disruption forms increases the vulnerability of supply chain processes, thereby creating more problems for production, distribution and consumption of products. Notable global incidents that have had consequential effects of supply chain processes across the world have emanated through the risks posed by natural and man-made disasters such as global terrorism, Hurricanes Katrina, Harvey, Helene (in 2005, 2017, and 2024, respectively, in the United States) and 1998 Hurricane Mitch in South America, Indian Ocean tsunami and earthquake of 2004, 2011 Tohoku tsunami in Japan, South Korea floods of 2024, the collapse of Baltimore Key Bridge, and the US Dockworkers strike of 2024. In adjusting to the unfavorable influence of supply chain disruption on their industrial processes, companies like HewlettPackard, Cisco, Procter & Gamble, SYSCO, and Walmart have developed a supply chain risk management (SCRM) process to mitigate the vulnerability of their supply chain management to risk and disruptions. The question is, are the self-developed supply chain risk management processes "resilient" (Sheffi, 2005) and "robust" (Tang, 2006)?

In the times past, several risk response strategies have been deployed by organizations to mitigate the risk of supply chain processes and increase reliability in logistics operations. Total quality management (TQM), Just-In-Time (JIT), First-In-First Out (FIFO), Last-In-First-Out (LIFO) were among the popular strategies adopted in mitigating disruptions in supply chain operations across sectors, industries and economies. The approaches failed in the presence of complex and more globalized supply chain activities and their vulnerabilities to change in culture, language, ripple of effect of regional problems, natural and man-made disasters, and terrorism. The world of supply chain management, as a matter of necessity, is gravitating towards the adoption of enterprise risk management (ERM) to manage both the risks and disruptions plaguing the logistics processes. The ERM is an alternative strategy for companies in the management of perceived risks associated with their logistics operations due to its ability to identify, evaluate, and mitigate risk holistically.

Although, the concept of enterprise risk management was initially adopted in financial risk management, its ability to aid the development of supply chain process that is agile, resilient, robust, and able to recover from the shock of disruptions in

a complex and interdependent supply chain networks endears the concept to researchers and the companies. It is against this backdrop that the study examined the application of ERM concepts in building supply chain resilience in the industrial sector of the United States. By reviewing the literature and analyzing a case study, the study examined the role of ERM in building a resilient and robust supply chain risk management in the United States. In particular, the objective of the study is to examine the prospects and the challenges of adopting enterprise risk management in supply chain risk management. The paper contributes to knowledge by identifying the role of ERM in handling the complexities and risk-related disruptions in organizational supply chain processes with particular focus on supply chain activities in the United States' industrial sector.

II. LITERATURE REVIEW

Business operations, manufacturing, distribution, and recycling are risk prone endeavors. The extent of risk encountered determines, to a large extent, the success of operations and profits. Risk in supply chain is one of the most critical problems that have perennially plagued manufacturing and distribution of products, to which there are constant efforts at mitigating in order to improve the welfare of consumers, sustain production, and keep manufacturers' profits level at all time high. This section of the paper reviews relevant theories on risk management, their adaptability to supply chain operations, the United States' industrial sectors, and the past studies on the application of ERM in mitigating supply chain risk exposures.

2.1 Conceptual Review on Supply Chain and Risk Management

Studies have adopted different definitions of concepts to explain the role of risk of disruptions in supply chain management. Further than explaining the risk, recommendations have been made to industries on mitigating the risk and boosting reliability and reducing vulnerability in supply chain processes. Some definitions and concepts are examined in this subsection.

2.1.1 Conceptual Definitions of Terms

Supply Chain

Risk

Supply Chain Risk



2.1 Review of Theories on Supply Chain and Risk Management

Many theories have been advanced to explain the relevance of supply chain and risk management in manufacturing, services industries, and industrial processes. A few of the theories are discussed briefly.

2.1.1 Resource-Based View (RBV)

The Resource-Based View theory was propounded by Penrose (2009), who emphasizes the role of materials in aiding a company's competitive advantage in production and distribution of products Utami & Alamanos (2023). The theory asserts a positive role for resource use in production, and more importantly, the theory suggests that a production company can hedge out competition by considering the location of production based with full cognizance of access to resources like materials, finance, and quality labor. focuses on the RBV theory may be described as a framework used by firms to plan production of goods alongside customers' satisfaction by focusing attention on the efficient use of resources. Akanbi, *et al* (2024) raw materials and labor supply are critical factors that are capable of boosting productive activities of firms, when the RBV theory is carefully deployed. In relation to risk mitigation, movement of raw materials, equipment, and workforce are important areas of attack. The deployment of RBV theory can assist firms in mitigating risk relating to the strategic movement and use of the important production resources. The contributory ability of supply chain management to production and distribution of goods may be hindered by the exposures to the risk of globalization and interdependencies of suppliers and producers. Therefore, in mitigating the risk associated with supply chain management, the RBV theory can play unimaginable role.

2.1.2 Materials Logistics Management Theory (MLMT)

Although, the origin of the Materials Logistics Management theory cannot be traced to any individual, the theory deals with the basic components in production and supply, which are the materials. Materials in the context of MLMT refers to not only the raw materials used in production but also the semi-finished goods, as well as the primary or secondary products that are imputable into the production of tertiary goods. This theory emphasizes the planning and coordination of materials distribution within the context of supply chain and production. More than focusing on logistics operations of moving finished goods, the MLMT

emphasizes a hitch-free supply of materials between the supply points to the request points. With reference to building construction, Kassim (2015) emphasized the relevance of the MLMT theory in conducting and coordinating materials flow for construction projects, especially in the area of planning, procurement, supplier evaluation, warehousing, and inventory operations.

2.1.3 Transaction Cost Theory (TCT)

Transaction Cost Theory is a theory that is capable of explaining the part of supply chain processes that is prone to certain risks. For instance, consumers' demands or expectations play important role in the suppliers' supply. Although, Say's Law states that supply will always create its own demand, the cost implication poses a great risk to repeated purchases of a product. In economics, it is believed that all consumers are rational, and that they seek to maximize their utility, while all producers are equally rational in that they seek to maximize their profits. The interplay between these entities determines what transaction will be successful, and which will be unsuccessful. Increasing transaction cost poses a risk to demand for a product. Gradual decline in product demand will also affect projections made between supplier and producer. Therefore, in mitigating supply chain risks, the role of transaction theory cannot be neglected.

2.1.4 Material Flow Theory (MFT)

Material flow theory is a model that is used in supply chain management to plan and implement strategic policies on sourcing materials for production purposes and includes how the goods get to the end-users. Material flow theory provides a strategic opportunity for firms to see the end from the beginning, thereby giving them the privilege to plan, envisage and mitigate any risk that may be lurking in the supply chain process.

2.1.5 Enterprise Risk Management Theory (ERMT)

Enterprise risk management theory is a multifunctional theory that has roots in financial risks management. Its concept of risk or losses identification, assessment, and mitigation has been extended to other parts of strategic management, the supply chain management inclusive. The ability to identify supply chain associated risks, assess their far and near impacts, and taking steps to mitigate the effect of risks endears the ERM theory to businesses and firms. The plurality of supply chain related risks poses a threat to the actualization of companies'



objectives. The applicability of the ERM theory on supply chain risk mitigation has been conceptualized, hypothesized, and tested by various studies. These studies have affirmed positive impact of the ERM concepts on mitigating supply chain risk (Ganiyu, Yu, Xu, & Providence, 2020; Dabari & Saidin, 2024)

2.2 Supply Chain Management, and Risk Related Disruptions in the United States

Manufacturing activities involve the transformation of raw materials into finished products with the aid of people, process, and equipment, to satisfy societal and corporate goals. The process of manufacturing goods in the US is highly standardized and requires a supply chain process that is strictly adherent to regulatory framework, which covers trade regulations and legal restrictions (Kusrini & Hanim, 2021; Okoye et al. 2024). The manufacturing sector, for over a century, has remained a critical sector in the United States. The sector is the highest contributor to the US GDP. In 2023, about 10.2%, representing \$2.3 trillion was the share of the manufacturing sector to the US GDP (NSIT, 2024). The sector also boasts of about 10% employment share of the US total employment for 2023, and its manufacturing value added (direct and indirect purchases from other industries) was estimated to contribute 17.1% to the US GDP in the same year. According to Boyle (2021), healthcare, technology, construction, retail, and non-durable manufacturing are the major drivers of the US economy. Interestingly, the products and services offered in the five major drivers rely on a smooth, resilient, seamless, effective, and efficient supply chain management. These supply chain characteristics, without risk effect, are capable of generating positive multiplier effects for the US economy.

Industrial or manufacturing processes rely on supply of materials that are mostly sourced globally, requiring shipment regardless of the political, social, economic, and/or natural challenges affecting the source, the routes, and the destination of the materials (Manuj & Mentzer, 2008). In the opinion of Hejazi, Alrusaini, & Beyari (2022), unexpected disruptions in supply chain, regardless of its nature or source tends to have a negative effect on the operational performance of companies. The authors also identified supply disruption, demand disruption, and process disruption are the three sources of disruptions that may affect supply chain management. Since the interdependence of many US companies on global supply chain, any disruption, perceived or actual, that affect the *source*

of materials will affect the planned *destination* of the finished products. This view was shared by Jüttner, Peck & Christopher (2003), who asserted that past events have shown that any disruption affecting any part of the supply chains may have a direct effect on a manufacturer's ability to continue in producing or getting finished products to the end users. Intuitively, when the problem persists, brand loyalty suffers, and the organization's reputation begins to dwindle until it gets to a halt.

Studies have established that it is not only external disruption that can affect an organization's operational performance (Jüttner *et al.*, 2003; Truong, Quang, & Hara, 2018). In the opinion of Duong *et al.* (2023), the ripple effects of external risks can have debilitating risk effect on the internal supply chain strategy. Although, some studies recommended a consideration of locally sourced supply chain points, others have asserted that the internal supply chain mechanisms are not entirely immune to the risk of disruptions. As posited by Dolgui & Ivanov (2021) as little as one or more disruptions are experienced in the supply chain network, the risk may spread to other parts of the supply chain network, causing multiple effects in the demand, the supply of materials and the operation of the affected company. Besides the ripple effects of external shocks, the internal supply chain risks may emanate from fire hazards, extreme weather conditions, terrorism, war, political instability, epidemics, pandemics, and other natural and man-made disasters.

Industrial production in the United States is prone to both local and international disruptions. These disruptions were described by Neureuther (2009) as demand volatility, increase in disruptive events, and complex global supply chain network. However, without adequately envisaging the risk-related disruptions, providing strategic solutions will remain challenging. This assertion is further corroborated by Duong et al (2024, p1), which opined that "the propagating impacts of a disruption make local disruptions unpredictable, thus it is hard for managing them." As such, without proper understanding of the disruption-causing risks, finding solutions to local supply chain problems. In her opinion, Akinbolajo (2024) asserted that the continued sustenance of the manufacturing sector, in the US or any other parts of the world, is achievable when the supply and the demand sides of supply chain function appropriately. Therefore, once the issues of supply chain disruptions become unresolved, the continued survival of the firm becomes threatened. Okoye *et al.* (2024, p259) concluded that the disruptions in the US supply



chain process may be mitigated by the adoption of “technological solutions, real-time tracking, and data analytics”.

2.3 Supply Chain Management and Enterprise Risk Management

Enterprise risk management is a concept of risk management adoptable by companies for mitigating perceived and actual risks arising from finance, demand, supply, and operations. Enterprise risk management was defined by Sprčić, Kožul, and Pecina (2015, p767) as a “combination of activities and strategies that results in reduction of a negative impact of various types of risks - financial, operational and strategic - to the planned business results and value created to shareholders and other company’s stakeholders.”

According to Dabari & Saidin (2014), enterprise risk management is a strategic concept by which firms align the critical components of their operations, that is, the people, the process, available technology, and knowledge for identifying, assessing, mitigating the risks associated with firm. ERM is a choice strategy for companies in that, it provides them the opportunity to envisage how risk and its consequences affect their operations (procurement, production, distribution, and customers’ satisfaction), thereby giving them the firsthand opportunity to evaluate and mitigate them.

The role of ERM in supply chain management is still emerging. Although, many studies have been conducted on their interconnection, there are still many areas uncovered. In the words of Bartram (2000) as corroborated by Sprčić (2015), effective management of risk is a critical determinant of how firms handle competitive advantage, thereby leading to a critical determinant of firms’ survival.

The ERM concept, as applicable in all strategic and risk management areas, has three major components: risk identification, risk assessment/evaluation, and risk mitigation. The COSO framework of the ERM identifies eight strategic components, which include: internal environment, setting of objective(s), identification of event, risk assessment, risk response, risk control activities, information and risk communication, and monitoring. The eight components are the major drivers of a firm’s risk management through the ERM concept. Although, their application has yielded some positive outcomes in supply chain risk management, its application is still yet to be experimented by many companies around the world.

III. METHODOLOGY

The research design is qualitative. It explores a conceptual framework to explain the application of the enterprise risk management concept in supply chain risk management. Many papers have adopted a conceptual framework that explained how supply chain risk can be mitigated, thereby enhancing the optimal operations of companies (Jüttner *et al.*, 2003; Manuj & Mentzer, 2008; Delgado & Mills, 2020; Basuki, 2021). The study designed a conceptual framework to guide companies in the integration of ERM into supply chain risk management to mitigate both the upstream and downstream risks.

3.1 The adoption of Enterprise Risk Management in Supply Chain Risk Mitigation

The enterprise risk management is a concept that explains how identification, assessment, and mitigation of risk can aid the efficiency in a company’s operations. In the concept designed for integrating ERM into SCRM, it is essential that a company that is adopting the ERM takes the steps annotated in Figure 1.

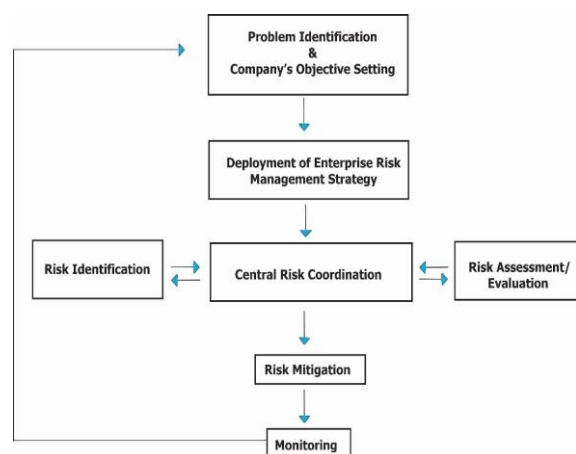


Figure 1: Conceptual framework for adopting ERM in SCRM

Source: Authors’ Construct (2024)

Step 1:

The starting point is for a company adopting the concept to first identify the problem of risk that brings about the vulnerability of its supply chain process. Stating the problem to be solved provides the company a guide to seeking a tailored solution. For instance, the business may need to expand its supply of products, as a consequence, the supply chain network must also be expanded. To give credence to the problem identification, it is necessary that the objectives of the company and its



vision are clearly and unambiguously stated to guide the further pursuit of risk management.

Step 2:

There must be a resolve to deploy the ERM concept in fighting the company's supply chain vulnerability that may lead to disruptions in the free flow of materials and products.

Step 3:

The company must set up a central risk coordination center, where all arms and departments of the company report any perceived or realistic risks are reported. According to Manuj & Mentzer (2008), it is not all risks that can be completely avoided. Therefore, envisaging a risk before its practical manifestation plays a crucial role in risk management. It is important for risk officers to be employed in all departments to identify, and report risk related issues to the centralized risk office for proper assessment with a view to designing a mitigation strategy.

Step 4:

Risk identification. It is pertinent for the central risk office to have the ability of envisaging all risk-related vulnerabilities that may confront the firm. It is critical to consider in detail, financial risk, operational risk, supply risk, technological adoption risk, upstream and downstream risks, process risk, regulatory and compliance risk, etc. At this level of risk management, the central risk office, having identified the risk must analyze the risk in terms of its consequence on the firm. There are production delay consequences, firm's reputation attack consequence, financial loss consequence, and the risk of business collapse. The level of the risk will determine the mitigation strategy that needs to be deployed. This process is called risk assessment or evaluation.

Step 5:

Risk mitigation. There are many strategies for responding to the chances of risk occurring. Interestingly, each solution to risk problem also carries some levels of risk. While it is impossible to envisage all possible risks, the ability of the company in managing the perceived ones may reduce the effect of the unexpected risks. The company, through the central risk office must deploy a strategy that addresses the perceived risk. Most companies encounter challenge in their digitalization process. Digitalizing supply chain process or deploying a new supply chain software has created risk-related vulnerabilities for big

manufacturing companies in the past. The companies willing to migrate their process from manual to digital or hybrid must consider the risk involved and the consequences it may have on their operation and reputation.

Step 6:

The last step is to ensure the installation of a risk management monitoring process. The findings from the deployment of the risk mitigation strategy will provide a feedback to the company, who may need to make strategic improvements in goal and vision setting as well as identifying a new problem.

An effective deployment of the six steps is a proof of deployment of the enterprise risk management, which seeks to cover the entire risk of an enterprise as against the risk of each unit in isolation of others.

IV. THE CHALLENGES OF THE ERM DEPLOYMENT IN SCRM

The deployment of the ERM concept in tackling disruption related supply chain risks may be counteracted by some inherent challenges. Envisaging the challenges puts an adopting company at a vantage position to provide a holistic approach to the deployment. The following challenges are envisaged with a high probability of occurring.

4.1 Risk Measurement

The first step in finding solution to an identified risk is to measure, evaluate, assess, understand the risk and its magnitude; to understand if it is peculiar to upstream, downstream or both. Many organizations may encounter this challenge in the deployment of the ERM concept in SCRM. Some risks may be complex or multifaceted in nature. If not properly identified and assessed, the efforts at mitigating such risks are bound to hit the rocks.

4.2 Incubation Period of the Change

Every process has a period under which it must mature. The same principle applies to every paradigm shift in a business. To launch a system requires some period to be standardized and functionally efficient. If the incubation process of the deployment of ERM is not well articulated, the business may encounter some surprises that will make the supply chain processes more susceptible to disruption or risks.

4.3 Hitch in Technological Changes

Migrating between old and new technologies in supply chain for better operational efficiency may encounter some technology related challenges. For



instance, deploying a new software in a full capacity may create some operational hiccups, that may expose the adopting organizations to different degrees of risks. For a successful operation, testing the a risk mitigation process and deploying it gradually and strategically may save the organization a lot of unexpected shocks. When mishandled, shocks to supply chain may affect a company's operation, profits, reputation and survival.

V. LIMITATION OF THE STUDY

The study is basically qualitative and exploratory. Access to useful and quality data may offer new insights into the empirical relation of the ERM adoption in supply chain risk management. The study is limited to the conceptual analysis of the plausible integration of the supply chain risk management by the enterprise risk management concept.

VI. CONCLUSION AND RECOMMENDATIONS

The application of Enterprise Risk Management, a concept that considers the risk of an entire company, in building supply chain resilience has been discussed in this study. Risks are the unavoidable parts of a business venture. Identifying them and taking steps towards mitigating their effect on business outcomes plays an important role in business operations. The role of enterprise risk management in supply chain risk management has received little attention form the literature. In order to bridge this gap, this study designed a conceptual framework to explain the application of the ERM concept in supply chain management for the purpose of mitigating disruptions that may arise through the known and the unknown risks. Some challenges that may impede the successful integration of the ERM concept in supply chain management were identified, which include risk measurement difficulty, weathering the storm of the strategy incubation period, and adapting to technological changes. This study concludes that the deployment of the ERM concept in industrial production will ensure supply chain resilience by identifying, assessing, and mitigating the common and uncommon risks that cause supply chain disruption.

It is hereby recommended that a company that is desirous of integrating the ERM concept in management risks and supply chain disruptions must do so in stages, observe the likely challenges and resolve them before expanding the scope. In essence, the company must also deploy the ERM concept within the downstream supply chain

network before expanding to the upstream network. There is also the need to embrace training and retraining of staff as a key delivery strategy for the deployment.

Author's Contributions

Munsifaruddin Mohammed conceived the idea, downloaded literature for reviews, and took part in the writing. Williams Adeyemi designed the conceptual framework, contributed to the writing of the paper, and reviewed the manuscript.

Conflict of Interest

There is no conflict of interest relating to the study.

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