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## Effect of Environmental Uncertainty and Supply Chain Flexibility towards Supply Chain Innovation: An exploratory study

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### Abstract

The concept of supply chain management (SCM) is receiving greater attention among academicians and organizations and thus it is viewed as a potential source of bottom and top-line growth. Despite the potential for improving organizational performance through supply chain activities, little scholarly evidence exists in management literature to establish an association between organizational factors and SCM performance outcomes. Businesses that are seeking to achieve competitive advantage are forced to compete beyond the firm level to the supply chain level. As a supply chain competes with other supply chains, businesses would see that supply chains that are flexible will outperform those that are less agile in an increasingly uncertain environment. What it means is that, supply chain flexibility has emerged as an important management strategy to achieve competitive advantage and so businesses now have to look into improving their supply chain management practices to become flexible and responsive to an unpredictable environment and to cope with changing customers' requirements.

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## 1. Introduction

A supply chain management (SCM) practice is a set of three or more entities (organizations or individuals or a multi-dimensional construct that encompasses upstream and downstream sides of supply chain. It comprises of the flow of products, services, finances, and or information from source to customer (Jr, Whitten, & Inman, 2008). The success of supply chain management encompasses customer integration at the downstream and supplier integration at the upstream, considering that each entity in a supply chain is a supplier as well as a customer (Sukati, Abu, Abdul, Prof, & Baharun, 2011). As a concept it is now well established, and its adoption has helped many firms to gain a competitive edge (Christopher & Holweg, 2011). It is also a set of values-adding activities connecting the enterprise's suppliers and its customers (Sukati, Hamid, Baharun, & Yusoff, 2012). The supply chain includes manufacturer, suppliers, transporters, warehouses, retailers and even the customers themselves. Within each organization, such as a manufacturer, the supply chain includes all functions that are involved in receiving and filling a customer request. These functions include new product development, marketing, operation, distribution, finance, customer service and other functions that are related to serving customer request. Thus effective supply chain management is important to build and sustain competitive advantage in product and services of the firms (Sukati et al., 2012). Earlier studies have identified components of supply chain practices such as outsourcing, supplier partnership, information sharing, cycle time, compression and continuous process flow, quality, purchasing and consumer relationship (Sukati et al., 2011).

The traditional supply chain management model is manufacturer-centric whereby manufacturers formulate their production plans based on demand forecasts and most of them keep safety stock to mitigate the risk of stock-outs. However, there are often gaps between forecast and actual demand, which can result in excessive stock and create cash flow problems for the enterprises concerned (Economic, 2007; Hua, 2013). In addition, most supply chains are a combination of production processes and service operations.

Supply chain management has emerged as common practice across industries because it encompasses long-term strategic alliance, supply-buyer partnerships, cross-organizational logistics management, joint planning, control of inventory and information sharing (Karami et al., 2014). In addition, the growth of supply chain aims to improve profitability, customer response and ability to deliver value to the customers and also to improve the interconnection and interdependence among firms (Sukati et al., 2011). By improving the competitive advantage of the firm, organizations could improve its overall performance and thus might be able to be the biggest player in a specific consumer market. Therefore supply chain management can be concluded to mainly encompasses four areas: raw materials supply, production planning, logistics and customer demand (Hua, 2013).

Studies on supply chain management have covered a wide variety of industries stretching from automotive, fashion, ship building industry (Ali, Jaafar, & Mohamad, 2008; Hua, 2013), pharmaceutical, apparel, chemical, computer, telecommunication, agriculture/food, grocery (Christopher & Holweg, 2011), manufacturing (Sukati et al., 2012) and children's toys (Wong, 2005). Major drivers of supply chain management are supply chain partnerships and coordination, supply chain flexibility capability and development and use of information systems besides supply chain process optimization and management philosophy, attitude and support of top management (Hua, 2013).

Little academic research has been done to determine both external and internal factors that affect supply chain performance namely environmental uncertainty and supply chain flexibility (Merschmann & Thonemann, 2011; Xu, Zhao, Li, & Sun, 2010). As diversity and uncertainty in the environment increases, companies are responding by adding flexibility as a dimension to their operation strategies (Martí, 2005). Flexibility is not only a response to changes in demand as there are many other reasons why supply chains may need to be flexible so as to be used proactively (Stevenson & Spring, 2007).

This model proposed here fits the description of a "conceptual model" as it "integrates a number of different works on the same topic, summarizes the common elements, contrasts the differences and extends the work in some fashion" (Duclos, Vokurka, & Lummus, 2003).

This paper will begin by reviewing the literature to provide definitions of supply chain performance concepts. From there, a brief review of environmental uncertainty and supply chain flexibility is provided. A review of the limited literature on environmental uncertainty and supply chain flexibility will then be discussed. Finally, a conceptual model of supply chain performance and its factors is proposed.

### *1.1 Environmental Uncertainty*

Environmental uncertainty refers to uncertain changes occurring externally and the degree of instability in the business environment that may occur at any point within a global supply chain network and might result in an inability of an organization to understand, estimate, make sense of how an environment might change, the potential impact of the changes, and whether an organization's response to such changes might be successful or not (Library, 2012; Oke, Walumbwa, & Myers, 2012; Srinivasan, Mukherjee, & Gaur, 2011; Wang, Yeung, & Zhang, 2011; Yi, 2011). Dynamic environments may be characterized by changes in technologies, variations in customer preferences, and fluctuations in product demand and/or the supply of materials. Such unexpected changes require that firms develop the capability to understand and adapt to environmental changes. This is because these forces have a large impact on a firm's competitiveness and shape its structures and operating procedures. (Huang, Yen, & Liu, 2014). Firms need to recalibrate their strategies and use different rules of engagement because the changes in uncertain environments are often frequent and rapid (Xu et al., 2010). For inter-firm collaboration, environmental uncertainty cannot be ignored and a supply chain's performance may vary under the high pressure of environmental uncertainty.

Environmental uncertainty is multidimensional in nature and as a result, firms frequently face multiple environmental uncertainties concurrently (Huang et al., 2014). Uncertainty in the supply chain can take many forms, e.g. uncertainty regarding the reliability of suppliers, the actions of competitors, or the quality of products (Stevenson & Spring, 2007). Simangunsong, Hendry, & Stevenson (2011) stated that while there have been much research done on specific sources of supply chain uncertainty such as on internal manufacturing processes, supply-side processes or demand-side issues, there are still many other distinct sources of uncertainty that has yet to be explored such as determining a comprehensive understanding of the many sources of uncertainty and how these can be aligned with management strategies in order to improve supply chain performance, thereby developing theory in this area. In addition, since supply chains consist of partnerships between various organizations, environmental uncertainty may affect the relationship between partnership quality and supply chain performance especially if the level of uncertainty is higher. This might results in increased risk of opportunistic behavior by the partners (Srinivasan et al., 2011). Furthermore, firms should maintain their flexibility to switch suppliers by avoiding close supplier relationships in uncertain environments (Huang et al., 2014).

Major sources of environmental uncertainties are customers (demand), suppliers (supply), technology (structural) and competitors (Fynes, de Búrca, & Marshall, 2004; Wong & Boon-itt, 2008; Huang et al., 2014; Hua 2013; Xu, Zhao, Li, & Sun, 2010), while other earlier studies have identified several sources of uncertainty such as demand, manufacturing process, supply and control uncertainty. Other sources can be classified as contingent models as they are made for specific purposes such as in the food and fashion industry; chain configuration; infrastructure and facilities; order forecast horizon; information technology complexity and human behavior. Three main groups of uncertainty that have been identified and taken from previous studies are internal organization uncertainty (comes from the focal company), internal supply chain uncertainty (arises within the realm of control of the focal company) and external uncertainties (factors outside the supply chain) (Simangunsong, Hendry, & Stevenson, 2011).

There have been contrasting views on the effect of environmental uncertainties towards supply chain partnerships. On one end, firms will coordinate their activities more closely in an attempt to reduce uncertainty if the

level of uncertainty is high. On the other end, firms will try to maximize their flexibility in uncertain environments by reducing their reliance on interfirm relationships. Thus, perceived environmental uncertainty exerts significant influence on organizational processes (Srinivasan et al., 2011).

### *1.2 Supply chain flexibility*

Flexibility may be defined as the ability to meet an increasing variety of customer expectations with little penalty in time, effort, cost, disruptions or performance in order to compensate for changes in the environment in order to gain and keep a competitive advantage (Blome, Schoenherr, & Eckstein, 2014; Economic, 2007; Marti, 2005). From the robust network point of view, offering flexibility refers to the ability of an existing SC linkage to support changes in product or service offerings in response to changes in the business environment (Stevenson & Spring, 2007). Time factor, trimming inventory levels, shortening delivery times and lowering capital rations can also significantly contribute towards reducing operation costs (Hua, 2013). It can also improve competitor's competitiveness, particularly for the decision-making process of implementing technologies.

One strategy for gaining and keeping a competitive advantage in a dynamic environment is to create an entire flexible organization that is not only associated with manufacturing capabilities but also with the linkages between raw material provider to consumer which is basically the whole supply chain (Stevenson & Spring, 2007). This indicates that supply chain performance should not only have superior in-bound logistics capabilities but also superior customer satisfaction (Hua, 2013; Srinivasan et al., 2011).

In today's business environment competition is no longer between companies but rather supply chains competing against other supply chains (Economic, 2007; Karami et al., 2014). Given that firms' supply chains now compete rather than the individual firms, the importance of network of firms within a firm's supply chain to the achievement of firm flexibility cannot be over-emphasized.

In environments with high uncertainty, companies should focus on flexibility (Merschmann & Thonemann, 2011) since it enables firms to adapt to unforeseeable technological and market changes (Wang et al., 2011). In addition, components of flexibility vary from supply chain to supply chain (Stevenson & Spring, 2007). The present, highly competitive, manufacturing climate is characterised by increasingly sophisticated consumers that demand customised products and short lead times. Therefore many companies that have previously relied on order winning through low cost standardised production have had to become more flexible in order to compete with other competitor (Stevenson & Spring, 2007). Thus, supply chain flexibility is widely seen as one major response to the increasing uncertainty and competition in the global, Web-linked marketplace environment of today (Duclos et al., 2003). It is achieved if the key processes have the ability to respond and adapt effectively to disruptions in supply and changes in demand along all major supply chain key performance versus their largest competitors for the main objective of satisfying customer needs (Economic, 2007; Merschmann & Thonemann, 2011; Stevenson & Spring, 2007). Its benefit lies in the ability to facilitate the development of meaningful organizational strategies and guidelines that improve overall firm performance. In addition, enhancing supply chain management flexibility has practical implications for enterprises. This is due to the fact that rapid economic and technological developments have created large uncertainties for internal (marketing and manufacturing) and external (suppliers, information systems providers and channel members) supply chain environments (Economic, 2007; Hua, 2013).

In order to win competitively, supply chain enterprises must be able to deal with external and internal uncertainties. Even though there has been a tremendous amount of research on the topic of flexibility, most of it has been confined to intra-firm flexibility concerns (Duclos et al., 2003; Stevenson & Spring, 2007). According to Stevenson & Spring (2007), by making use of existing frameworks, supply chain flexibility can be placed above manufacturing flexibility in the flexibility hierarchy because it has the ability to incorporate all the internal issues inherent at the plant and firm-level together with a wider range of (non-manufacturing) services and external/inter-firm sources of flexibility at the network-level, including sourcing, procurement and logistics.

These studies concluded that improving supply chain flexibility and adaptability to deal with changes in internal and external environments are the future directions for the automobile industry (Hua, 2013; Marti, 2005). Supply chain flexibilities can consist of operation system, market, logistics, supply, organizational and information systems, procurement, manufacturing R & D, distribution, and the launch of new products (Duclos et al., 2003; Economic, 2007; Hua, 2013).

Supply chain flexibility has been suggested as an approach for coping with sources of uncertainty. For example, at the process stage, labor and machine flexibility can be used to manage equipment, people and infrastructure uncertainty. At the output stage, customer flexibility is used when customers are less sensitive to delivery dates or products (Simangunsong, Hendry, & Stevenson, 2011). The need for flexibility originates from customers; since customers ask for variety, quality, competitive prices, and faster delivery. This has forced companies to make design changes quickly and respond faster to customer needs in order to sustain the company's competitive advantage. As a result, companies need to be flexible enough to react to changes in customers demands (Sukati et al., 2012).

## **2. Effect of environmental uncertainty and supply chain flexibility on supply chain innovation**

Innovation is a highly structured, knowledge-intensive activity embedded in networks that span organizational boundaries. One important member of the supply chain is the supplier and they are important sources of innovative ideas and critical technologies (Wang et al., 2011). Therefore, since innovation is no longer a part of a firm's internal activities, suppliers should be treated as part of a firm's business and technical functions.

Early studies have identified the importance of innovation as a competitive weapon to achieve superior performance in highly turbulent environments. For example, when the dynamism in the environment is high, firms are likely to constantly introduce radical innovations that differentiate their products from existing products to enable them to achieve superior performance. In addition, when the environment is highly complex, firms seek innovations that give them superior performance through external networking with external agencies (Oke et al., 2012). Meanwhile in recent times researchers have focused on innovation as a key contributor to competitive advantage and survival of firms (Cao & Zhang, 2011; Oke et al., 2012; PwC, 2013). Supply chain partnership innovativeness enhances a firm's innovation strategy which in turn positively influences innovation performance. Effect of supply chain partnership innovativeness on product innovation strategy could be further enhanced by innovation climate and having strategic relationship with key supply chain partners. Effect of supply chain partner innovativeness on innovation strategy is enhanced when firms have stronger strategic relationship with their key supply chain partners.

The contingency theory posits that there is no best way to organize an organization, implying that "the best way to organize depends on the nature of the environment to which the organization relates". Thus it can be rationalized that an organization can employ suitable management practices that positively impact its innovation performance. The role of environmental uncertainty as a contingent factor in the relationship between innovation and performance has been examined and proven by several studies (Oke et al., 2012). Innovation is more difficult to be implemented in firms that are facing uncertain environments due to lack of previous knowledge, thus making experiential learning, improvisation and flexibility necessary. Firms in volatile and hostile environments had a higher innovation performance than those in stable environments. This is because firms in turbulent environments are more aggressive in terms of executing innovation strategies enabling them to quickly take advantage of opportunities offered in such environments. As a result these firms will be able to create innovations and new products and services that will meet the needs of niche and emerging new markets and it will enable them to achieve superior innovation performance.

Flexibility value manifest in terms of tangible and intangible benefits. The balance scorecard concept advocates that organizations seek to balance performance on all financial and non-financial aspects. In their study (Soon & Udin, 2011), it is proven that by being flexible in the value chain, tangible gains such as supply chain cost and profitability can be achieved by efficient inventory turn model. In Thailand's automotive industry, the level of supply chain is found to be associated with environmental uncertainty. Companies are attempted to achieve higher

level of supply chain integration especially when they faced high levels of supply, customer and technology uncertainty (Wong & Boon-itt, 2008). In another study carried out by Fynes, de Búrca, & Marshall, (2004), they proved that firms that have a match with their environmental context can improve their performance but those that have a mismatch, or respond too slowly to change, court failure and poor performance.

In the manufacturing strategy literature, environmental uncertainty is proved to affect performances such as quality, dependability, and cost; thus, the literature suggests manufacturer to increase flexibility to cope with high level of environmental uncertainty (Merschmann & Thonemann, 2011; Wong & Boon-itt, 2008). Several studies that applied the resource dependence theory, transaction cost theory and contingency theory also support the idea that in uncertain times, stronger relationships allow the firm to draw the necessary resources from partners in order to sustain performance. This indicates that companies that match environmental uncertainty and supply chain flexibility achieve higher performance than companies that do not match environmental uncertainty and supply chain flexibility. Integration or quasi-integration may also be due to uncertainty in the environment (Fynes et al., 2004).

Operations management literature has often treated both innovation and flexibility as competitive criteria. In other words, they are seen as the outcome variables or as operations performance objectives of firms. However, there have not been much studies done linking innovation and flexibility (Oke, 2013). Results from a study carried out by Oke (2013) proved that there is a positive relationship between flexibility (mix and labour) and product innovation.

### 3. Conclusion, limitation and future research

Our study suggested a relationship between environmental uncertainties, supply chain flexibility and supply chain innovation. There are certain limitations that must be taken into consideration despite the interesting findings of this study. For example, this study only discusses the effect of supply chain flexibility and environmental uncertainty on supply chain innovation briefly. Several management theories have been mentioned briefly in relationship to either supply chain flexibility or environmental uncertainty. It would be interesting to explore several theories and relate them to both supply chain flexibility and environmental uncertainty and how they can contribute toward supply chain innovation.

This study is not without limitations. It is explorative in nature and without empirical validation; the inferences of the relationship will not be valid. At this stage, we are not able to test any relevant hypotheses. While we acknowledged that the study has limitations, it has also provided interesting contributions. First, we explored the potential relationship of collective supply chain practices that should create flexibility. Environmental uncertainties also played a role in contributing towards supply chain innovation. Our conclusion through extensive literature review indicated that supply chain flexibility and environmental uncertainties should be a combination of integrative efforts of operation processes that would lead to more innovations being introduced to the supply chain.

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