SUPPLY CHAIN DESIGN, OPERATIONAL CAPABILITIES, AND FIRM PERFORMANCE: THE ROLE OF INTERNAL AND EXTERNAL ENVIRONMENT

by

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DISSERTATION

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DEDICATION

This work is dedicated to loving memory of my father, Chaudhary Naphe Singh, who made his journey to heaven in 2016. He is my strength and inspiration. I could not have made this far without his guidance and blessings.

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I want to express my sincere gratitude to the people who supported me to accomplish this work. Words are not enough to express adequate gratitude; please consider big thanks from the bottom of my heart.

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ABSTRACT

SUPPLY CHAIN DESIGN, OPERATIONAL CAPABILITIES, AND PERFORMANCE: THE ROLE OF INTERNAL AND EXTERNAL ENVIRONMENT

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Supply chain agility has been the cornerstone of research in supply chain management field. Despite the benefits associated with pursuing agile supply chain strategy, little is known about how the agile supply chain strategy stimulate better performance for the firms. Also, there is a lack of understanding of the conditions under which agile supply chain strategy impacts the performance. Through the theoretical lens of strategy, structure, performance paradigm, knowledge-based view, and contingency theory, this research examines the linkages from agile supply chain strategy to mass customization capability (MCC), and operational ambidexterity (OA). This study also examines the association between MCC, OA and multiple dimensions of the performance. Moreover, this research examines the role of MCC and OA as the

means to achieve the objective of agile supply chain strategy. Furthermore, this study investigates the critical role played by strategic integration, environmental uncertainty, and internal integration from a contingency perspective.

The data was collected from 302 supply chain professionals working at US manufacturing firms. Structural equation modeling (SEM) was used to analyze the hypothesized relationships. The results demonstrate that agile supply chain strategy is positively associated with MCC and OA. This research shows that MCC and OA are critical capabilities that enable the company to compete on multiple dimensions of performance. Also, the results indicate that MCC partially mediates the relationship agile supply chain strategy and cost, quality, delivery, flexibility, and business performance. On the other hand, OA partially mediates the relationship between agile supply chain strategy and cost, delivery, and flexibility. Further, OA fully mediates the relationship between agile supply chain strategy and quality.

The results uncover the importance of strategic integration by demonstrating that strategic integration has a direct association with MCC in addition to moderating the relationship between agile supply chain strategy and MCC. This study also indicates that the relationship between MCC and cost, quality, flexibility, and business performance becomes stronger under the condition of high environmental uncertainty, thereby providing evidence of the effectiveness of MCC. Further, the results reveal the importance of internal integration by showing that higher the internal integration, the stronger the association between OA and cost, and flexibility. Based on the findings of this study, research and managerial implications are discussed.

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CHAPTER 1

1.1 Introduction

In the current business environment, the focus of competition has shifted from the firm level to the supply chain level (Ketchen & Hult, 2007; Li et al., 2006). This compels organizations to identify new pathways to enhance performance and attain competitive advantage (Zhang et al., 2012). Supply chain management (SCM) is touted as a new pathway or a competitive weapon to build a sustainable competitive advantage (Li et al., 2005; Shin et al.,2000; Spekman et al.,1998). Therefore, SCM has attracted the attention of practitioners as well as academics (Qi et al., 2009). For example, the successes of Wal-Mart, Toyota and Dell are attributed to effective SCM (Ketchen & Hult, 2007). Similarly, the importance of SCM from an academic perspective is reflected in the statement by Thun (2010, pg. 1) that, "In the past decades, supply chain management has evolved as a major discipline in operations management." The literature delineates two perspectives on SCM. According to the first perspective, SCM is defined as a mechanism for the flow of goods and materials (Ketchen & Hult, 2007) to achieve low prices and supply certainty (Spekman et al., 1998). This perspective reflects the operational view of SCM (Gunasekaran et al., 2004). The operational view of SCM, at best, works as a support function of the organization and does not reflect the characteristics of the "best value supply chain" (Ketchen & Hult, 2007).

According to the second perspective, SCM is viewed as a gateway to improving the outcome for the organization and is referred as strategic supply chain management (Ketchen & Hult, 2007). The strategic SCM perspective treats SCM as the critical element in the strategy of the organization (Ketchen & Hult, 2007), and "this strategic view is encapsulated in the concept of the supply chain strategy" (Qrunfleh & Tarafdar, 2013, pg. 1). In other words, supply chain strategy is critical to the effectiveness of the organization's SCM (Qi et al., 2009), because

supply chain strategy dictates the goals of the firm's supply chain, which in turn directs the focus of the supply chain to achieve those objectives (Tarafdar & Qrunfleh, 2017). The SCM literature offers different typologies of supply chain strategy (Qi et al., 2011) but a widely used classification recognizes two generic forms: the lean and agile supply chain strategies (Qi et al., 2017).

The primary objective of the lean supply chain is to reduce any waste and achieve cost efficiency (Christopher & Towill, 2001; Fisher, 1997; Lee, 2002; Wang et al., 2004). However, cost-efficient supply chains alone are not sufficient to achieve competitive advantage in the 21st century (Ketchen et al.,2008; Lee, 2004). Lee (2004) observed that despite increased efficiency in the supply chain, the market mediation cost rises substantially in the US from 1980 to 2000, resulting in more dissatisfied customers. On the other hand, agile supply chains respond quickly and cost-effectively to unexpected changes in supply and demand (Lee, 2004). Agile supply chain fulfills the ultimate aim of SCM that is to enhance efficiency as well as the effectiveness of firm's supply chain that will lead to firm's competitive advantage (Mentzer et al., 2001). Supply chain agility is the source of competitive advantage for many firms, especially "in an environment, where the only constant is change" (Blome et al.,2013). Accordingly, the focus of this dissertation is on the agile supply chain strategy (ASC) of the firm.

Despite the beneficial impact of supply chain agility (Swafford et al., 2006), the research on supply chain agility is in nascent stage (Braunscheidel & Suresh, 2009). Most of the research on supply chain agility focuses on the operational level of supply chain agility. For example, researchers have used supply chain agility as performance outcome and explored the antecedents such as manufacturing flexibility, supply chain flexibility, information technology,

and supply chain practices of supply chain agility (Braunscheidel & Suresh, 2009; Gligor & Holcomb, 2012; Swafford et al., 2006; Swafford et al., 2008). On the other hand, some researchers have explored the impact of supply chain agility on the operational and financial performance of the organization (Gligor et al.,2015; Gligor & Holcomb, 2012a; Swafford et al., 2008). While most of these studies emphasize the operational level of supply chain agility, the research on the strategic view of supply chain agility is entirely unexplored (Gligor & Holcomb, 2012b). Accordingly, this research investigates supply chain agility from the strategic perspective of the focal firm.

1.2 Research Gap and Research Questions

Although the SCM literature has recognized the importance of supply chain strategy, there is limited research in the field of supply chain strategy. Supply chain strategy has been examined in the literature either through a focus on the direct relationship or a focus on supply chain practices with the performance of the firm. For example, Fisher (1997) took the strategic view of the supply chain and stated that firms should choose their supply chain based on their product characteristics. According to Fisher (1997), firms with standardized products should choose lean supply chain whereas firms with innovative products should pursue agile supply chain and the perfect match between product attributes and supply chain will lead to better performance for the organization. A few researchers have tested Fisher's work empirically (See Qi et al., 2009; Selldin & Olhager, 2007), but the results were mixed. For instance, Selldin & Olhager (2007) did not find the empirical evidence for the claim that lean supply chain had a stronger positive impact on cost compared to the agile supply chain. Also, their study did not find support for the assertion by Fisher (1997) that firms with the innovative product type will pursue an agile supply chain. However, the study by Qi et al., (2009) found evidence for the argument that firms with agile supply chain will have more innovative product

compared to firms with lean supply chain. Moreover, these studies try to establish a direct relationship between supply chain strategy and performance without explaining how the supply chain strategy influences the firm's performance.

There is lack of studies on how the supply chain strategy influences the firm performance. However, recently, some researchers have paid attention in this area by looking into the role of supply chain practices. For instance, Tarafdar & Qurenfleh (2017) studied supply chain practices as a mediator between agile supply chain strategy and supply chain performance but with mixed results. For example, in their study, strategic supplier partnership, an example of upstream external integration practice fully mediates the relationship between agile supply chain strategy and performance but customer relationship, a type of downstream external integration, did not mediate the relationship between agile supply chain strategy and performance. In another study, Qi et al. (2017) investigated the relationship between both lean and agile supply chain strategy and supply chain practices (internal and external integration). The results of their study indicate that both lean and agile strategies influence both types of supply chain practices, but the degree of emphasizes on each of supply chain practice is different. For example, lean supply chain focuses more on both types of supply chain practices (internal and external integration) in comparison to agile supply chain. Also, their study did not find support for the positive impact of external integration on firm performance. The above studies, although advance our understanding of the role of supply chain practices as a link between supply chain strategy and firm performance but have significant drawbacks when it comes to capturing the relationship between supply chain strategy and performance of the firm in a more holistic manner. One of the major drawbacks of prior studies is that it does not give any clear explanation of the use

of resources to support the firm's supply chain strategy. If one looks at the result of Qi et al. (2017) study, the results suggest that firm must integrate internally and externally irrespective of firm's supply chain strategy, which does not give any direction to practitioners on how to utilize their resources to support the firm's supply chain strategy.

Also, the focus of earlier studies is on the relationship between supply chain strategies, especially agile strategy, and supply chain practices. In the operations management literature, there is now an overall consensus that supply practices are static in nature and do not provide a competitive advantage to firms (Su et al., 2014). For example, Rungtusanatham et al., (2003), based on the tenets of resource-based view (RBV), argued that supply chain linkages are resources that have the VRINN (valuable, rare, imperfectly mobile, non-imitable and non-substitutable) attributes, which can provide a competitive advantage to the organization. However, they also reasoned that this competitive advantage is short-lived because competitors will imitate them. Similar logic has been offered in other studies. For instance, Wu et al. (2010) posit that resources are static and that resources by themselves do not create a sustained competitive advantage because they lose value over time (Coates & McDermott, 2002). D'aveni et al. (2010) lend support to the argument mentioned above by stating that resources, at best, can provide only a temporary advantage due to quick imitation by competitors.

If competitive advantage obtained via practices and resources is temporary, then the capability approach is the path forward to remain ahead of the competitors (Su et al., 2014) for the following reasons. First, capabilities are ingrained in the dynamic interplay of multiple knowledge sources, thereby having more firm-specific attributes that facilitate the creation of competitive advantage for the organization (Peng et al.,2008). Second, implementing practices "does not constitute capabilities" (Narasimhan et al., 2005). For example, automobile

manufacturers have implemented the Toyota production system but failed to realize the expected improvement in performance like Toyota (Narasimhan et al., 2005). It is not the implementation of practices, but rather the development of capabilities that holds the key to improved organizational performance (Narasimhan et al., 2005) because operational capabilities are developed through a different bundle of routines (Peng et al., 2008). Similarly, Wu et al. (2010) delineated the difference between resources, practices, and capabilities. Third, the strategy emphasizes specific objectives of the firm and managers need to understand what type of capabilities they should develop to support the firm's strategy (Peng et al., 2008). Accordingly, this research will focus on the role of operational capabilities in the agile supply chain strategy domain as scholars have identified and encouraged future research to provide a clearer understanding of the relationship between supply chain agility and organizational performance (Gligor et al.,2015).

The primary goal of agile supply chain strategy is to respond quickly in a cost-effective manner (Lee, 2004; Swafford et al., 2006). Supply chain capabilities are the "secret ingredient" (Su et al., 2010) that can full fill the objective of agile supply chain strategy, i.e., efficiency and effectiveness. Mass customization capability (MCC) and operational ambidexterity (OA) are two operational capabilities that can help the firm achieve efficiency and effectiveness simultaneously (Kortmann et al., 2014). Accordingly, the current research will examine the relationship among agile supply chain strategy, internal operational capabilities (MCC and OA), and the firm performance.

Researchers have recognized that the success of a strategy is contingent on the uniformity of decisions that support the goals of the strategy (Boyer & McDermott, 1999). Consistency in decision making is a function of communicating the strategy to members of the firm to fulfill the

specific objective of the firm (Boyer & McDermott, 1999). The lack of a mechanism to permeate the supply chain strategy among members of the organization might have resulted in mixed results in the supply chain strategy field. For example, Hallgren & Olhager (2009) observed that cost strategy is negatively related to agile manufacturing practices, but Qi et al. (2011) found a positive association between cost strategy and agile supply chain strategy. Other studies have found inconsistent results in investigating the relationship between supply chain agility and performance. For instance, Gligor et al., (2015) posit a positive association between agility and cost and provide empirical evidence to support their argument. On the contrary, Hallgren & Olhagar (2009) did not find a significant association between agility and cost performance.

Similarly, Selldin &Olhager (2007) found no significant difference in the impact of agile and lean practices on quality performance, while Hallgren & Olhager (2009) found that lean manufacturing practices perform better than agile manufacturing practices when it comes to quality. These inconsistent results may stem from a lack of communication of supply chain strategy among members of the organization. This research takes the position that strategic integration is the mechanism to augment the consistency of decision making, which in turn enhances the influence of agile supply chain strategy on the development of operational capabilities. Also, a review of the literature on strategic integration suggests that it is a vital ingredient in the development of organizational capabilities (Swink et al. 2005). Therefore, this research will explore the role of strategic integration to understand the relationship between agile supply chain strategy and operational capabilities.

One operational capability being investigated in this research is mass customization capability (MCC), and previous literature sheds some light on the impact of MCC on performance. However, there are inconsistencies in these results, and this may be attributed to

the context because it may be possible that the relationship between MCC and performance is not same in different environments. Researchers also have recommended exploring contextual factors to ascertain the effectiveness of manufacturing practices (Sousa & Voss, 2008). It is apparent from MCC literature that MCC is successful in industries characterized by the demand for new products (Kotha, 1996), short product lifecycles, and fragmented demand (Kotha, 1995). Mass customization is a different paradigm from mass production (Kotha, 1995), which emphasizes lean practices (Duguay et al., 1997). Lean practices lead to better performance in a stable environment (Azadegan et al. 2013; Duguay et al. 1997). This implies that mass customization might be more effective under high environmental uncertainty due to the above-stated difference between mass customization and mass production. So, it is worthwhile to investigate the relationship between MCC and firm performance when the external environment is uncertain. In other words, this research will examine the moderating role of environmental uncertainty to understand the relationship between MCC and performance.

This research will also investigate the impact of operational ambidexterity (OA) on firm performance. OA is the learning capability of the organization (Patel et al., 2012), so it tends to create new knowledge for the firm. The knowledge management literature supports the notion that firms should have a mechanism to integrate knowledge (Grant, 1996; Nonaka, 1994) that can help firms combine and create new knowledge to enhance their performance. This research takes the position that internal integration is the mechanism that can help the firm to combine the knowledge generated through OA, which in turn will amplify the impact of OA on the firm's performance. In other words, this study will examine the role of internal integration as a moderator between OA and organizational performance.

To summarize, the following research questions will be examined in this study:

1. What is the relationship between the firm's agile supply chain strategy and its mass customization capability (MCC)?
2. What is the relationship between the firm's agile supply chain strategy and its operational ambidexterity (OA)?
3. How do the firm's mass customization capability (MCC) and operational ambidexterity (OA) impact the firm's performance?
4. Do mass customization capability (MCC) and operational ambidexterity (OA) mediate the relationship between agile supply chain strategy and the firm's performance?
5. Does strategic integration moderate the relationship between the firm's agile supply chain strategy and its mass customization capability (MCC)?
6. What is the relationship between strategic integration and the firm's mass customization capability (MCC)?
7. Does environmental uncertainty moderate the relationship between mass customization capability (MCC) and the firm's performance?
8. Does internal integration moderate the relationship between operational ambidexterity (OA) and the firm's performance?

1.3 Research Approach

A multi-disciplinary approach is employed in this dissertation to address the above-stated research questions. The Strategy-Structure-Performance (SSP) theoretical lens will drive the relationship among agile supply chain strategy, MCC, OA, and performance from the focal firm's point of view. Contingency theory (CT) will guide the strength of the relationship between agile supply chain strategy and MCC in the presence of low and high levels of strategic

integration within the firm. Also, CT will help to explain the role of MCC in changing the environment to yield a precise understanding of the conditions under which MCC will impact the performance of the organization. Finally, the knowledge-based view (KBV), as a theoretical lens, will be used to examine the role of internal integration. This theoretical lens will aid in determining whether internal integration makes operational ambidexterity (OA) more worthwhile for the firm by augmenting the firm's performance.

In this study, the firm is the unit of analysis. Survey methodology is used to collect data to test the hypothesized relationships. Structural equation modeling is used to evaluate the hypotheses that form the theoretical model.

1.4 Significance of Research

This research offers several significant theoretical and managerial contributions. Scholars have called for additional investigation to understand the relationship between supply chain agility and performance (Gligor, 2016; Gligor et al., 2015). Accordingly, this study extends the supply chain agility literature by investigating the association between an agile supply chain strategy, mass customization capability and operational ambidexterity. Specifically, this study provides insight as to how agile supply chain strategy can lead to better performance through the development of mass customization capability and operational ambidexterity. To the best of the author's knowledge, this is the first empirical study to examine the relationships among agile supply chain strategy, capabilities (MCC and OA), and firm performance. Also, this research responds to calls for additional research to examine the 'capability perspective' rather than the 'practice view' in the supply chain management domain (Su & Linderman, 2016). Moreover, this is the first study to examine the role of strategic integration in accentuating the relationship between agile supply chain strategy and mass customization by highlighting the importance of

the communication of supply chain strategy within the organization to focus resources in the right direction in order to achieve the firm's strategic goals.

This dissertation also contributes to theory development by examining the impact of mass customization capability and operational ambidexterity on the individual dimension of operational performance. The investigation of multiple dimensions of operational performance provides a comprehensive understanding of the relationships between MCC, OA, and firm performance. In addition to examining the direct relationship between operational capabilities and multiple dimensions of performance, this study seeks to determine the conditions under which these operational capabilities are effective. Accordingly, this research argues that the impact of MCC on all dimensions of operational performance and business performance is stronger when environmental uncertainty is high. Similarly, this dissertation posits that the higher the internal integration within the firm, the higher is the impact of OA on all four dimensions of operational performance.

From the perspective of practitioners, this study will provide managers with evidence of the usefulness of cultivating MCC and OA to achieve the efficiency and effectiveness goals of agile supply chain strategy. The results of this study will guide managers in utilizing scarce resources to fulfill the objective of their chosen supply chain strategy. Also, the results of this dissertation will help managers understand the potential benefits of investing in particular capabilities. Also, this study will inform managers on the importance of communication of strategy within the organization to achieve the objectives of their supply chain strategy. Furthermore, the results of this study will help managers identify the contextual variables in order to have better understanding of effectiveness of MCC and OA.

CHAPTER 2

2.1 Introduction

In this chapter, the literature review of all the constructs used in this study is presented. First, the literature review will synthesize all the previous studies related to agile supply chain strategy, mass customization capability, and operational ambidexterity. Second, this chapter will summarize literature about strategic integration, internal integration, environmental uncertainty, and performance. Finally, this chapter will introduce the theories that will be a building block to develop the framework and hypotheses presented in chapter 3.

2.2 Agile Supply Chain Strategy

The current business environment has witnessed the shift of the competition among firms from firm-level to the supply chain- level, which requires a new way of managing the business (Lambert et al., 1998). Supply chain management (SCM) represents a new pathway to manage the business in the current business environment (Lambert et al., 1998) because it facilitates the long-term performance not only for the focal firm but also for its partners (Li et al., 2006). The significance of SCM in providing competitive advantage has led to considerable interest in SCM both from business press and academia (Lambert & Cooper, 2000). Despite the importance of SCM, there is no precise definition of SCM (Mentzer et al., 2001). Due to ambiguity around SCM, Mentzer et al., (2001, pg. 18) defined SCM as, " *the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole*." This holistic view of SCM highlights the importance of the strategic perspective of the supply chain (Vickery et al., 2003), which is embodied in the firm's supply chain strategy.

Supply chain strategy aims to provide the right product at a right price and at the right time, that is critical not only for competitive advantage but also for the survival of the organization (Towill & Christopher, 2002). The SCM literature has established different typology of supply chain strategies (Qi et a., 2011), but can be classified in two generic form: lean and agile (Qi et al., 2017).

Fisher (1997), in his seminal article on supply chain strategy, assigns the lack of improvement in supply chain performance to missing supply chain framework, which can help the supply chain managers to take actions according to their firm's unique situation. He asserted that the organizations should consider the characteristics of their products and create a supply chain to support it. In other words, supply chain strategy is a function of the characteristics of a firm's product type. He classified the products into two categories: functional and innovative and asserted that firms with the functional product should pursue an efficient supply chain while firms with innovative products should pursue market responsive supply chain. These two type of supply chain are nothing but lean and agile supply chain respectively (Qi et al., 2009). Lee (2002) stated that there are many supply chain concepts or fads, which are being employed by firms, but they do not represent the supply chain strategy of an organization.

" One size fits all" supply chain strategy is bound to fail, and the firms should develop supply chain strategy based on the need of its customers as well as supply and demand characteristics unique to them (Lee, 2002). Lee (2002) advocated four supply chain strategies based on uncertainties related to supply and demand faced by the firm:- efficient supply chain, risk-hedging supply chain, responsive supply chain and agile supply chain. An efficient supply chain in Lee's (2002) article can be labeled as a lean supply chain, whereas agile supply chain strategy consists of both risk hedging and responsive supply chain.

In addition to the lean and agile supply chain, scholars have argued about another supply chain strategy called "Leagility" which is a combination of both lean and agile supply chain (Naylor et al., 1999). They advocated that total supply chain strategy requires both lean and agile paradigm. Lean should be used in the upstream supply chain, and agile should be used in the downstream supply chain to meet the demand of the customer (Naylor et al., 1999). Mason-Jones et al., (2000) emphasized the understanding of market and customer satisfaction to choose the appropriate supply chain strategy. They also demonstrated in their case study that in addition to the lean and agile supply chain, leagility exist in the real world. There are other scholars, who have supported the notion of leagility in addition to lean and agile supply chain (Bruce et al., 2004; Goldsby et al., 2006; Naim & Gosling, 2011; Purvis et al., 2014; Vonderembse et al., 2006). It is apparent from the literature that there are several classifications of supply chain strategy, but most of the prior research has focused on lean and agile (Qi et al., 2011).

Lean supply chain falls under the umbrella of lean thinking (Qi et al., 2017). The primary objective of the lean supply chain is to develop a value chain to eliminate all waste including time and pursue a level schedule (Naylor et al., 1999), and to provide " right material, at the right time, at the right place and in exact quantity" (Qrunfleh & Tarafdar, 2013. pg. 573). Lean supply chain strategy requires a stable product demand that will facilitate short cycle time, lower work in process and finished goods inventory (Qi et al., 2009). The scholars have used the functional product as an example of stable demand. For example, Lee (2002) stated that firms with low demand and supply chain uncertainties should adopt lean supply chain strategy and should pursue optimization, economies of scale and elimination of the non-value added activities. Also, researchers have argued that the firm should pursue lean supply chain strategy when the firm supplies functional products (Huang et al., 2002; Vonderembse et al., 2006).

Despite the theoretical argument that lean supply chain strategy is suitable for the functional product, Qi et al., (2009) study finding did not support the claim that lean firms emphasize more on the functional product in comparison to agile firms. In addition to product characteristics, scholars have examined the relationship between lean supply chain strategy and other variables such as business strategy (Qi et al., 2011), environmental uncertainty (Qi et al., 2011), operations strategy (Qi et al., 2017), information technology (Qrunfleh & Tarafdar, 2014), and supply chain integration (Qi et al., 2017; Qrunfleh & Tarafdar, 2013).

The firm's success depends upon its ability to adapt and respond quickly in the turbulent business environment (Overby et al., 2006). Agility, the ability to sense and respond quickly, is imperative for an organization to be successful in the current business environment (Overby et al., 2006; Sambamurthy et al., 2003). Even though the construct of agility has some commonality to theoretical concepts such as dynamic capabilities, market orientation, strategic flexibility and absorptive capacity, it is conceptually different from them (Overby et al., 2006). The literature of agility argues that the concept of agility is "domain specific" and can be operationalized at various level of an organization (Roberts & Grover, 2012b, 2012a). For instance, the concept of agility has been investigated at the enterprise level (Overby et al., 2006), customer level (Roberts & Grover, 2012a), manufacturing level (Hallgren & Olhager, 2009), and supply chain level (Braunscheidel & Suresh, 2009; Gligor et al., 2015; Gligor & Holcomb, 2012a; Swafford et al., 2006). In this thesis, the focus is on supply chain agility of the focal firm. The literature of supply chain agility suggests two dominating themes surrounding the supply chain agility. The first theme, which has dominated most of the literature on supply chain agility, has taken a performance perspective to study the supply chain agility. In other words, most of prior studies on supply chain agility have examined the impact of practices such as supply chain integration

(Braunscheidel & Suresh, 2009), supply chain flexibility (Swafford et al., 2006) ,information technology (Liu et al., 2013; Swafford et al.,2008; Yang, 2014), supply chain and market orientation (Gligor et al., 2016), strategic sourcing and strategic flexibility (Chiang et al., 2012), supply and demand side competence (Blome et al., 2013) on supply chain agility of the firm.

The second theme of supply chain agility is related to the strategic view of supply chain agility and research from this perspective is still in nascent stage (Qi et a., 2009). Fisher (1997) and Lee (2002) were the first few authors, who studied the supply chain from a strategic perspective. Fisher (1997) advocated that product characteristics should be considered when contemplating the right type of the supply chain strategy for the firm. He proposed that an efficient supply chain strategy should be pursued for functional products and responsive supply chain strategy for the innovative products. Lee (2002) classified the supply chain strategies as efficient, responsive, risk-hedging and agile supply chains based on supply and demand uncertainty. Agile supply chain strategy includes attributes of both responsive and risk hedging supply chains (Lee, 2002). Lee (2004) argued that efficiency alone does not make supply chain great, but it is the agility of the supply chain, which makes the supply chain great. Similarly, Ketchen & Hult (2007) argued that agile supply chains represent the 'best value supply chains.' The strategy of a firm's supply chain reflects the " goal and objective of its supply chain" (Qrunfleh & Tarafdar, 2013). Agile supply chain strategy of a firm reflects the goal of responding quickly to changing requirement of the customers (Qi et al., 2009; Qi et al., 2011; Qrunfleh & Tarafdar, 2014; Wang et al., 2004) in an efficient manner (Lee, 2004).

In early 2000, the research on the strategic aspect of agility was limited to conceptual arguments (Christopher, 2000; Christopher & Towill, 2001), case study (Vonderembse et al., 2006), and mathematical modeling (Wang et al., 2004). Selldin and Olhager (2007) were among

the first researchers to empirically study the domain of supply chain strategy. They tested the Fisher (1997) model and found mixed results. For example, the relationship between a responsive supply chain and innovative products type was not significant. Also, the responsive supply chain with innovative products type did not perform better on flexibility when compared to a lean supply chain strategy. Qi et al., (2009) tested the Fisher's model in the Chinese context and observed that lean group had a lower rating on innovative products type in comparison to the agile group but found no significant difference between lean and agile firms in case of functional products. Their study also found that lean and agile firms performed at the same level for customer service but the performance of lean firms was better on cost than that of agile firms. Scholars have examined some other variables such as business strategy (Qi et al., 2011), and environmental uncertainty (Qi et al., 2011) in addition to product characteristics (Qi et al., 2009; Selldin & Olhager, 2007).

Although these studies have advanced the field of supply chain strategy, the literature is almost void regarding how a particular supply chain strategy will lead to the better performance for the organization.

However, there is some attempt to understand the mechanism by which a particular supply chain strategy of a focal firm will lead to superior performance. For example, there a few studies, which have investigated the role of supply chain practices as a pathway to achieve the objective of an agile supply chain strategy. For example, Qruenfleh and Tarafdar (2013) investigated the role of postponement on the relationship between agile supply chain strategy and supply chain responsiveness. In addition to the study of postponement practice, Tarafdar and Qurenfleh (2017) studied the role of strategic supplier partnership and customer relationship with respect to agile supply chain strategy. Similarly, Qi et al., (2017) investigated the role of internal

and external integration within the context of supply chain strategy. The summary of empirical studies related to supply chain strategy is tabulated in table 1. Although these studies advance the theory development within supply chain strategy domain, these studies have shown mixed results. For example, Qi et al., (2017) article did not find a significant relationship between external integration and firm performance, which suggest that the firms pursuing agile supply chain strategy should focus on external integration, but it may not result in better performance. Also, the study done by Tarafdar and Qruenfleh (2017) did not support the argument that customer relationship mediates the relationship between agile supply chain strategy and performance.

The inconclusive findings could be due to difference across the firms regarding capabilities that will support the objective of agile supply chain strategy. It is apparent from the literature review that more needs to be done to understand the missing link between agile supply chain strategy and the performance of the focal firm. Moreover, scholars have also urged that more research should be undertaken to understand the mechanism through which agile supply chain strategy impacts the performance of the company (Gligor, 2016; Gligor et al., 2015; Qi et al., 2011). Accordingly, this research argues that mass customization capability (MCC) and operational ambidexterity (OA) are two capabilities that act as an intervening mechanism between agile supply chain strategy and performance of the firm, and will be investigated in this research.

Table-1 Summary of Empirical Research on Supply Chain Strategy

Sl no	Article	Findings of the study
1.	The Impact of Competitive Strategy and Supply Chain Strategy on Business Performance: The Role of Environmental Uncertainty (Qi et al., 2011)	In stable condition, cost strategy and differentiation strategy are significantly related to lean supply chain strategy and agile supply chain strategy respectively. Lean supply chain strategy is positively associated with the business performance but not the agile supply chain strategy. Differentiation strategy has no association with lean and cost strategy has no relationship with agile supply chain strategy. In the volatile condition, differentiation strategy has a positive relationship with agile supply chain strategy. Also, cost strategy has a positive relationship with both lean an agile supply chain strategy. Moreover, agile supply chain strategy has a positive association with business performance of the focal firm.
2.	The impact of operations and supply chain strategies on integration and performance (Qi et al., 2017).	Operational strategies such as cost, quality, and delivery are positively related to lean supply chain strategy. Flexibility is significantly related to agile supply chain strategy. Lean and agile strategy are both positively related to internal and external integration, but lean is more related to external integration than the agile strategy. Also, the internal integration is related to financial performance, and external integration is not related to financial performance.
3.	Lean and agile supply chain strategies and supply chain responsiveness: the role of strategic supplier partnership and postponement (Qrunfleh & Tarafdar, 2013).	Lean supply chain strategy is not related to supply chain responsiveness. Agile supply chain strategy has a positive association with supply chain responsiveness(SCR). SCR is positively related to firm performance. Strategic supplier relationship mediates the relationship between lean supply chain strategy and SCR. Postponement partially mediates the association between agile supply chain strategy and SCR.
4.	Supply Chain Strategy, Product Characteristics, and Performance Impact: Evidence from Chinese Manufacturers (Qi et al., 2009).	For innovative products type, the agile group has much higher value than the lean supply chain group. There is no difference in financial performance and customer service between lean and agile firms. Lean performed better in cost when compared to agile companies.

Table 1- Continued

Sl no	Article	Findings
5.	Agile supply chain strategy and supply chain performance: complementary roles of supply chain practices and information systems capability for agility (Tarafdar & Qrunfleh, 2017)	The results of this study are mixed. Strategic supplier partnership and postponement mediate the relationship, but customer relationship does not mediate the relationship between agile supply chain strategy and supply chain responsiveness. Information systems capability positively moderate the mediated relationships.
6.	Supply chain information systems strategy: Impacts on supply chain performance and firm performance (Qrunfleh & Tarafdar, 2014)	The lean and agile supply chain strategy both have a positive relationship with supply chain performance. Information systems for efficiency and flexibility positively moderate the relationship between lean, agile and supply chain performance. Supply chain performance mediates the relationship between supply chain strategy and firm performance.
7.	Linking products with supply chain : testing Fisher's Model (Selldin & Olhager, 2007)	The relationship between innovative products type and responsive supply chain is not significant. Innovative products type with a responsive supply chain does not perform better on flexibility.

2.3 Mass Customization Capability

The concept of mass customization (MC) started to gain attention during the late 1980s because it seems a viable strategy to survive in the highly competitive business environment (Silveira et al., 2001). There is a consensus on the definition of mass customization (MC) and is defined as the ability of the firm to produce based on customer requirement at higher volume and at low cost (Pine, 1993; Silveira et al., 2001; Tu et al., 2001). Kotler (1989) talked about the importance of MC from a marketing point of view, but it was work of Pine (1993) that highlighted the importance of MC from the operations management perspective. MC is a distinct

paradigm and should not be confused with another paradigm such as continuous improvement (Pine et al., 1993), and mass production (Kotha, 1995; Lau, 1995).

Since the early 1990s, the researchers have investigated the various aspect related to MC. For instance, Pine (1993) suggested that instead of competing on either cost or differentiation, companies can do both and MC can serve as " silver bullet" which can enable the firm to be efficient as well as innovative. Pine et al., (1993) explained the difference between mass production and mass customization and proposed that MC require a different way of doing business to make MC work as originally intended. They advocated different organizational structure, values, the role of management, ways of learning and involvement with the customers for successful implementation of MC. Similarly, Lau (1995) emphasized the role of cross-functional teams, flat organization, modular design, and role of information technology in the development of MC.

Since then, there is a considerable amount of research is done to examine the factors that influence the development of MC. Kotha (1995) described MC as a process to provide a variety of products through the application of technology and managerial tools and consider MC as a strategic choice for the firms to achieve strategic flexibility. He also explained, based on the case study of National Bicycle Industrial Corporation (NBIC) of Japan, that MC is also an enabler of knowledge creation and termed MC factory as "learner factory." The knowledge created through MC, along with the reduction in cost associated with diffusion of information directly from the customers, can help the firm to respond quickly and flexibly, thereby improving its competitive position (Kotha, 1995). Similarly, Kay (1993) described MC as a " set of management innovation" and demonstrated the benefits associated with the implementation of MC.

Lampel & Mintzberg (1996) expanded the concept of MC through the use of different stages of the value chain of the firm. They proposed the four stages of the value chain of manufacturing firm: design, fabrication, assembly, and distribution. They categorized five types of customization – pure standardization, segmented standardization, customized standardization, tailored customization and pure customization. The firm will move from pure standardization to pure customization as customization is moved up in the supply chain, i.e., from no customization at any stage to customization at the design stage (Lampel & Mintzberg, 1996). Some authors argued that a firm can customize not only through changes in the product itself but also through the depiction of the product itself. For example, Gilmore & Pine (1997) proposed four approaches concerning the change in the product and 'representation' of the product to customize:- collaborative, adaptive, transparent and cosmetic.

Adaptive customizers do not change either product or representation but allow customers to alter the product based on their usage, whereas cosmetic customizers do not change the product but change the representation (Gilmore & Pine, 1997). On the other hand, transparent customizers do make changes to products but not in portraying the products whereas collaborative customizer makes changes in both products and presentation of the products (Gilmore & Pine, 1997). Similarly, Duray et al., (2000) developed the typology of MC from an operations perspective. They classified MC into four categories, fabricators, involvers, modularizers and assemblers, depending on the point of involvement of customers in production cycle and type of modularity. The above studies have focused on the strategic choice perspective of MC and delineated different type of customization, various organization structural and infrastructural requirements to achieve MC and benefits associated with the implementation of MC.

Also, the literature on MC reveals the technical perspective related to MC. For example, Tseng et al., (1996) introduced the concept of design for MC (DFMC) and proposed the development of product family architecture, which permits the reusability/ commonality both in product design and in process selection, along with concurrent engineering that enables the organization to achieve MC. Quick responsiveness, variety, and efficiency are three aspects of MC, which can be achieved through reusability, product platform and integration of product development process (Jiao & Tseng, 1999). They also demonstrated that product family architecture (PFA) can act as an integration platform that can help in the utilization or capturing of commonality as well as the future design of products.

Although these studies shed light on MC, its benefit and various structural and infrastructural choices to achieve MC. The prior studies have used case studies to advance the concept of MC without offering how to measure MC that can help the researcher to empirical test the enabling factors as well as the benefits associated with MC. Tu et al., (2001) developed the instrument to measure the MC which include cost-effectiveness, volume effectiveness, and responsiveness and called it mass customization capability (MCC). They also demonstrated that time- based manufacturing practices act as an enabler for MCC and MCC leads to improved customer satisfaction.

Since then, there are a number of studies that have examined the antecedents of MCC. For example, some studies have focused on the technical aspect of manufacturing practices such as modularity based manufacturing practices (Tu et al., 2004), standardization and innovation (Wang et al.,2016). There are some studies that have focused on both technical and soft aspect of manufacturing practices such as work design (Liu et al., 2006), quality practices(Kristal et al., 2010), product modularity and inter-functional coordination (Ahmad et al., 2010), product

modularity , internal and external coordination (Zhang et al., 2014), and information technology (Peng et al., 2011) . Similarly, few studies have investigated the role of knowledge in the development of MCC such as internal and external learning (Huang et al., 2008) and absorptive capacity (Zhang et al.,2015). In addition, there are few studies that have studied the impact of behavioral practices such as functional integration (Liu et al.,2012), external integration (Fujun et al., 2012; Jitpaiboon et al., 2009; Jitpaiboon et al., 2013), and social capital (Zhang et al.,2015) on the development of MCC. The literature on MCC suggests the beneficial impact of MCC on firm performance, but there are only limited number of empirical studies that have investigated the impact of MCC on the performance of the organization. For example, the studies have found a positive impact of MCC on customer satisfaction (Liu et al., 2012; Tu et al., 2001), financial performance (Jitpaiboon et al., 2013), operational performance (Ahmad et al., 2010; Liu et al., 2012; Wang et al., 2016).

The literature on MCC suggests that most of the prior studies have focused on operational enablers of MCC. There is a dearth of empirical studies that have examined the interplay between a firm's supply chain strategy and MC strategy and researchers have also suggested studying the relationship between firm strategy and MC. For example, Fogliatto et al., (2012) in their review of MC articles suggested investigating the relationship between supply chain strategies and MC. Furthermore, the literature review of MCC on firm performance suggests a positive influence of MCC on firm performance, but no study has investigated the impact of MCC on the individual dimension of operational, and financial performance simultaneously. Moreover, the literature is mostly silent on investigating the contextual factors to examine the effectiveness of MCC. Accordingly, this dissertation will examine the relationship between agile supply chain strategy and MCC. Also, this research will examine the impact of MCC on cost,

quality, delivery, flexibility, and business performance of the firm. Furthermore, this study will examine the role of environmental uncertainty to understand the effectiveness of the MCC.

2.4 Operational Ambidexterity

March (1991) in his seminal paper argued that both exploration and exploitation are critical for the organization. The activities such as, "risk-taking, experimentation, search, flexibility" and activities such as " refinement, efficiency, selection" undertaken by the organization are called exploration and exploitation respectively (March, 1991). Both types of activities are critical for the organization because exploitative activities help the firms to survive in their current situation whereas exploration activities benefit firms when the environment changes (March, 1991). Despite the benefits of balance between exploitation and exploration, it is difficult to achieve as both compete for a firm's scarce resources (March, 1991). Exploitation and exploration require entirely different processes, structure and culture thereby create tension (He & Wong, 2004). So there is a trade-off between these two activities and firms that can manage these tensions can reap the benefits of the synergistic effects of exploration and exploitation activities (He & Wong, 2004).

Ambidexterity can help the organizations to reconcile the tradeoff between exploration and exploitation and that improves their long-term performance (Gibson & Birkinshaw, 2004). Organizational ambidexterity refers to the ability of the organization to, " implement both evolutionary and revolutionary change" (Tushman & O'Reilly, 1996). Evolutionary changes such as incremental innovation are critical for the short-run success of the organization whereas revolutionary changes such as discontinuous innovation are necessary for the long-run success of the organization (Tushman & O'Reilly, 1996). Evolutionary changes are beneficial during a stable environment, which is not the accurate picture of today's world and firms should embrace

revolutionary changes along with evolutionary changes (Tushman & O'Reilly, 1996). In other words, ambidextrous firms should pursue efficiency in their current operations and adapt as the environment changes (Gibson & Birkinshaw, 2004). The organizational literature has identified two types of ambidexterity. One is related to structural ambidexterity, and another one to contextual ambidexterity. Structural ambidexterity is achieved by creating a dual structure with one structure focuses on exploitation, and another structure focuses on exploration (Gibson & Birkinshaw, 2004). On the other hand, contextual ambidexterity is related to behavior capacity in which the entire organization is dedicated to achieving alignment and adaptability simultaneously (Gibson & Birkinshaw, 2004).

The concept of organizational ambidexterity has gained momentum in management journals as the number of articles published has increased from 10 to more than 80 from 2004 to 2009 (Raisch et al., 2009).However, the research on ambidexterity is limited in operations and supply chain management literature (Patel et al.,2012). In operations management, some scholars have argued about the trade-off between flexibility and efficiency, whereas other scholars suggest that the firms can manage this trade-off and can have superior performance (Adler et al.,1999). Adler et al., (1999), through a case study of Toyota plant in the USA, explained how the plant had managed the paradox of efficiency and flexibility. They identified four mechanisms- meta-routines, partitioning, switching and ambidexterity that help the plant to pursue both efficiency and flexibility. The outcome was improved performance, both in efficiency and flexibility at New United Motor Manufacturing, Inc. (NUMMI) plant (Adler et al., 1999). Kristal et al., (2010) advanced the discussion between efficiency and flexibility from plant level to the firm's supply chain level. They also advocated the complementary view over the trade-off view between exploitation and exploration at the supply chain level. They argued that

firms should pursue an ambidextrous supply chain strategy to compete in today's hypercompetitive environment. They also empirically demonstrated that ambidextrous supply chain has a positive influence on manufacturers operational combinative capabilities, and which in turn improves a firm's business performance.

Other scholars, especially in the supply chain field, have extended the concept of supply chain ambidextrous strategy. For example, Rojo et al., (2016) studied the influence of ambidextrous supply chain strategy on supply chain flexibility fit and firm performance in the Spanish manufacturing industry. In another study, Lee and Rha (2016) investigated how supply chain ambidexterity is developed and how it impacts supply chain disruption and firm performance in S.Korea. In addition to the study of ambidextrous supply chain strategy concept, Wong et al., (2013) studied the role of internal integration and external integration on the firm's product innovation, in Thailand automotive industry, through the theoretical lens of ambidexterity. Moreover, Blome et al., (2013) explored the ambidextrous governance (relational and contractual contract) impact on buyer's performance in the buyer-supplier relationship. The studies mentioned above empirically tested the ambidexterity concept in the supply chain in different countries and these studies suggest that ambidexterity helps the firms to improve both operational and financial performance.

On the other hand, Patel et al., (2012) focuses on the internal supply chain of the firm and articulated the term 'operational ambidexterity' and studied it at operational level rather than organizational level. Operational ambidexterity (OA) is the ability of the firm to pursue exploration and exploitation activities simultaneously (Patel et al., 2012). OA helps the firm to develop new competencies and refinement of existing competences concurrently (Patel et al., 2012). The study of Patel et al., (2012) extended the study of Swamidass and Newell (1987) by

investigating the moderating role of OA and operational absorptive capacity on the relationship between environmental uncertainty, manufacturing flexibility, and firm performance. The results of their study on small manufacturing firms support the complementary role played by OA in the relationship between environmental uncertainty, flexibility strategies, and performance. In addition to investigating the " when" effect of OA on flexibility and performance, Kortmann et al.,(2014) studied the "how" effect of operational ambidexterity on the relationship between strategic flexibility and operational performance.

In addition to the development of supply chain ambidexterity and operational ambidexterity concept, scholars have used ambidexterity theoretical lens to investigate other ambidextrous concepts such as product configuration ambidexterity (Salvador et al., 2014) , ambidextrous governance (Blome et al., 2013), balanced and complimentary supply chain integration (Wong et al., 2013). Regarding antecedents of ambidexterity, researchers have identified decision risk, structural differentiation and contextual differentiation as a critical antecedent of ambidexterity (Chandrasekaran et al.,2012). Also, the literature on ambidexterity in operations and supply chain domain have studied the impact of ambidexterity on performance dimension of the firm such as product innovation (Wong et al., 2013), supply chain disruption (Lee & Rha, 2016), and supply chain flexibility fit (Rojo et al., 2016).

This thesis, through the theoretical lens of strategy- structure- performance, will investigate whether the agile firms need to have OA to have better performance. Furthermore, Patel et al., (2012) described operational ambidexterity as a learning capability, which implies that operational ambidexterity facilitates knowledge creating routines for the organization. This thesis, through the theoretical lens of knowledge-based view, will investigate the role of internal integration, which is considered a knowledge integration and knowledge creation mechanism, as

a facilitator between OA and operational performance. To put it differently, this research will examine the role of internal integration as a moderator to investigate the effectiveness of OA.

2.5 Integration

From the system perspective, an organization is divided into different subsystem where each subsystem work on some part of the task (Lawrence & Lorsch, 1967). This creates a need for integration so that the organization as a system can be effective, which makes integration as one of an essential part of top management's job (Lawrence & Lorsch, 1967). Lawrence & Lorsch (1967, pg. 4) defined integration as, "the process of achieving unity of effort among the various subsystems in the accomplishment of the organization's task." Similarly, the supply chain should be considered as a system, which demands integration so that supply chain can create value (Vickery et al.,2003). Despite the importance of integration, there is a lack of consensus on the dimensions of integration in the supply chain field (Huo, 2012). For example, some scholars have used supply chain integration as single constructs such as vertical integration (suppliers and customers) (Frohlich & Westbrook, 2001), and vertical and horizontal integration (Vickery et al., 2003). On the other hand, there are scholars who have advocated that supply chain integration consist of three different constructs :- supplier integration, customer integration and internal integration and should be investigated individually to better understand the influence of each of the dimension on firm performance (Flynn et al., 2010; Huo, 2012; Wong et al., 2011). Although supply chain integration is gaining the attention of scholars (Huo, 2012), most of the studies have focused on external integration and "leaving out the important central link of internal integration" (Flynn et al., 2010, pg. 58). In this study, the focus will be on internal integration. There are two perspectives related to the internal integration in the supply chain field: strategic and operational level perspective. This research has incorporated both the

strategic level integration and operational level integration. Strategic integration and internal integration constructs reflect the strategic and operational level view respectively in this research.

2.5.1 Strategic Integration

It has been well documented in the literature that the fit between strategy and structural and infrastructural decisions will lead to better performance (Boyer & Lewis, 2002; Boyer & McDermott, 1999)). These decisions are being made every day at all levels of the organization, and lack of communication about the strategic objective within the organization will weaken the objectives or goals of the organization (Boyer & McDermott, 1999). For example, Skinner (1969) in his seminal paper on manufacturing strategy, argued that manufacturing tasks are done at a lower level with some assumption about the corporate strategy that is either wrong or wrongly interpreted. It implies the lack of communication of strategy within the organization, and that will lead to poor alignment between strategy and decisions to support the strategy. Internal agreement among various functions within an organization is one of the criteria to judge the relevance of the strategy (Hayes & Wheelwright, 1984, pg. 32-33), and integration is the means to achieve this consistency among various functions within the organization (Swink et al., 2005). Specifically, strategic integration is the practice that will allow the organization to have an internal agreement within the organization about the strategy (Swink et al., 2005).

Swink et al., (2005) defined the strategic integration as the interaction with other functional units in order to make sure that manufacturing strategy is well aligned with the internal and external environment of the plant. Ralston et al., (2015, pg. 51) defined the strategic integration as "the diffusion of firm-level strategy within functional departments and functional goals being aligned with, and communicated throughout the entire organization." Formal and

informal interactions among different members of the organization, frequent meeting to draft clear planning documents are some of the vital components of strategic integration (Swink et al., 2007). The underlying theme behind strategic integration is that communication of strategy, irrespective of the type of strategy (business or functional), throughout the organization, is critical to building a consensus that will lead to better alignment between supply chain strategy and action taken to support the strategy.

Despite the importance of strategic integration, there is a dearth of empirical research on the role of strategic integration. For example, Raltson et al., (2015) investigated the relationship between strategic integration and external integration and found that strategic integration is positively associated with the supplier and customer integration. This gives credence to the argument that strategic integration helps the organization to develop capabilities that can be a source of competitive advantage for the organizations. Swink et al., (2005) investigated the direct influence of strategic integration on plant operational performance as well as the moderating impact of strategic integration on the relationship between manufacturing practices and operational performance. However, the results of their study were mixed. For example, strategic integration was positively associated with cost efficiency and product flexibility but not with process flexibility. In another study, Swink et al., (2007) found that strategic integration is not associated with cost efficiency and new product flexibility but is positively associated with process flexibility. The literature review on strategic integration suggests that strategic integration can act as a complementary asset that can influence the relationship between the objective of the firm's strategy and the decision taken by the firm. Accordingly, this research will investigate the influence of strategic integration on the relationship between supply chain

strategy and the firm's operational capability (MCC). Moreover, this thesis will also investigate whether strategic integration has a direct influence on the development of MCC.

2.5.2 Internal Integration

Stevans (1989) highlighted the problems in the firm's supply chain and advocated for the need of integrated supply chain strategy to overcome those problems. He further articulated that the road to integrated supply chain strategy starts with "close interaction of all business areas," thus highlighted the need and importance of internal integration. In his article, he explained four stages of integration and internal integration is the third stage of integration and only after internal integration, the firm is in position to synchronize supply and demand and can help the firm to achieve integration with supplier and customer. Internal integration is a key link to gather information both from suppliers and customers that enables the organization to match demand with the flow of material to obtain real benefits (Stevans, 1989). Although the literature on supply chain integration has conceptualized the integration in different ways (Schoenherr & Swink, 2012), researchers have acknowledged that there are three main dimensions of supply chain integration:- external (suppliers and customer) and internal (Flynn et al., 2010; Huo, 2012; Schoenherr & Swink, 2012; Wong et al., 2011; Zhao et al., 2011). The scope of each of these three types of integration is different. For example, external integration is related to practices adopted by the firm with actors outside the firm boundary, whereas internal integration practices are limited to actors within the boundary of the firm with the aim of better coordination within and outside the boundaries of the firm (Gimenez & Ventura, 2005).

From the supply chain management literature perspective, there is considerable research on supply chain integration in last twenty years (Leuschner et al., 2013), but most of the research on supply chain integration is void of the role played by internal integration (Flynn et al., 2010).

In this thesis, the focus is on the role played by the internal integration. In literature, there are two perspectives on internal integration. According to the first perspective, internal integration is a coordination mechanism, which is critical for the development of the firm's other capabilities that will lead to a firm's competitive advantage. For instance, earlier studies on supply chain integration have proposed and found that internal integration is a crucial antecedent for external integration (Braunscheidel & Suresh, 2009; Huo, 2012; Yu et al., 2013)**.** The underlying premise of these studies is that the firm has to keep its house in order before embarking on relationships with members of its supply chain.

The second perspective advocates that internal integration is a knowledge integration resource that will enhance the effectiveness of the firm's other capabilities. For example, Schoenherr & Swink (2012) argued that internal integration is a proxy for a firm's absorptive capacity that helps the firm to identify, value, assimilate and exploit the knowledge. Similarly, Williams et al., (2013) advocated that information is scattered throughout the organizations and internal integration is a mechanism that can foster the absorption and utilization of knowledge. Zhao et al., (2011, pg. 19) defined internal integration as, "information sharing between internal functions, strategic cross-functional cooperation, and working together." These type of activities will help the organization to codify the information and generate a shared understanding within the organization (Yu et al., 2013), which is the key to knowledge integration within the organization. Based on the second perspective of internal integration, this thesis seeks to investigate whether internal integration acts as a knowledge integration mechanism and facilitate the impact of OA on the firm performance.

2.6 Environmental Uncertainty

Environmental uncertainty is the cornerstone of organizational theory and business policy literature (Swamidass & Newell, 1987). Lack of information about the environmental factors, uncertainty in the outcome of the decision, and difficulty in assigning the probability to outcomes of decisions are the three elements of uncertainty (Duncan, 1972). Duncan (1972) proposed two dimensions of the environmental uncertainty:- simple- complex and static-dynamic dimension. In simple- complex dimension, simple is related to a few factors and complex is related to a large number of factors (Duncan, 1972). Static- dynamic environment refers to change over time during which static factors remain stable but dynamic factors change over time (Duncan, 1972).

Since then, scholars have defined and used various measures of environmental uncertainty (Azadegan, Patel et al.,2013; Pagell & Krause, 2004). For example, Dess & Beard (1984) classified organization's task environment in three dimensions- dynamism, complexity, and munificence. According to them, munificence refers to growth and stability. Dynamism is related to change that is difficult to foresee, and complexity is related to different inputs and outputs (Dess & Beard, 1984). Wernerfelt & Karnani (1987)) defined environmental uncertainty in supply, demand, competition uncertainty and externalities. Supply, demand uncertainty and externalities closely resemble Duncan's (1972) dimension of static- dynamic whereas competition uncertainty is similar to simple- complex dimension of environmental uncertainty. Gupta et al., (1986) defined environmental uncertainty as lack of ability to predict about competitors, customers preferences, technology, and regulations. These scholars explain the source of uncertainty, but some researchers argue that it is equally important to study the type of uncertainty faced by the decision makers (Milliken, 1987).

Milliken (1987) delineated three type of uncertainties faced by the administrators- state, effect, and response uncertainty. State uncertainty is related to the unpredictability of all sources of the environment or one source of the environment; effect uncertainty is related to the impact of the environment on the organization, and response uncertainty is related to unawareness about the availability of actions or the outcomes of those actions (Milliken, 1987). Despite the disagreement on what constitute uncertainty or sources of uncertainty, there has been a long history of research on environmental uncertainty in strategic management literature (Milliken, 1987; Xue et al., 2011).

Environmental uncertainty has been studied from information processing, differentiation and integration perspective (Gupta et al., 1986) that highlights the lack of information and adaption done by the organization to have a fit with the environment. For this thesis, dynamism will be used as environmental uncertainty variable because manufacturing firms in current business environment consider the dynamism as one of their primary concerns (Azadegan et al., 2013), which has been echoed by other researchers also (Zhang et al.,2012). Dynamism is related to uncertainty in demand (Xue et al., 2011), change regarding frequency and amount (Azadegan et al., 2013), and instability and unpredictability of the environment (Keats & Hitt, 1988). These definitions fall under the umbrella of the static-dynamic dimension of environmental uncertainty identified by Duncan (1972). Scholars have used different conceptualizations of environmental uncertainty. For example, Wong et al., (2011) and Qi et al.,(2011) defined the environmental uncertainty inherited in their supply chain. However, Srinivsan et al., (2011) conceptualized the external environment in two distinct elements. The first element is related to change in supply and demand side and is considered internal to firm's supply chain, whereas the second component is related to change in the industry regarding the taste of customers, change in

competitors, and innovation (Srinivasan et al., 2011). The current study will operationalize the environmental uncertainty that will include the uncertainty about the firm internal supply chain as well as the uncertainty in the industry in which the firm operates. In other words, the focus will be on the rate of change in environments such as innovation, preferences of customers, and volatility in demand.

In operations management and supply chain management literature, there are two views on environmental uncertainty and organizational structure. The first view argues that environmental uncertainty shapes the organizational structure. For instance, Swamidass & Newell (1987) argued that the firms facing high environmental uncertainty should develop manufacturing flexibility. Similalry, Fisher (1997) argued that the firm should choose their supply strategy based on the characteristics of their products. The second view argues that fit between organizational structure and environment will lead to higher performance. For example, Merschmann & Thonemann (2011) stated that firms having higher supply chain flexibility would perform better during high environmental uncertainty. Also, Qi et al., (2011) argued on a similar line and demonstrated that agile supply chain strategy leads to better performance when the environmental uncertainty is high. This study has incorporated the second view of environmental uncertainty to investigate if MCC leads to better performance in high environmental uncertainty, which in turns will help in better understanding the effectiveness of MCC.

2.7 Performance

The strategy of the firm will establish the objectives of the firm, and these objectives are ultimately converted into performance measures or in other words performance is a measurable outcome of strategy (Defee & Stank, 2005). Although performance is a ubiquitous topic not only for academic researchers but also for practitioners (Venkatraman & Ramanujam, 1986), the

selection of appropriate measures of performance is a significant challenge (Flynn et al., 2010). The problem in the selection of the performance indicators is reflected in the following statement by Yamin et al., (1999, pg. 510) 10) "The treatment of performance in research settings is perhaps one of the thorniest issues confronting academic research today." From a supply chain management perspective, scholars have argued to use organizational performance, reflected in market-related as well as financial goals as the performance outcome (Li et al., 2006), but this performance indicator reflects a limited measure of organizational performance (Yamin et al., 1999). Accordingly, it has been advocated that organizational performance should include not only the financial but also the non-financial indicators because non-financial indicators are more accurate and timely (Injazz J Chen & Paulraj, 2004; Yamin et al., 1999). Also, they argued that financial measures can be influenced by the factors outside the boundary of the firm whereas operational measures (non-financial indicators) are the reflection of actions within the firm. Moreover, "operational performance measures provide a relatively direct indication of the efforts of the various supply chain constructs" (Chen & Paulraj, 2004, pg. 146).

Chen and Paulraj (2004) proposed that operational performance measure should include both the efficiency and the effectiveness and from the SCM perspective, these two are the primary objective of the SCM (Mentzer et al., 2001). Effectiveness reflects the degree to which goals are achieved, whereas efficiency reflects how well the inputs are being utilized (Mentzer & Konrad, 1991). Neely et al., (1995) argued that the effectiveness dimension refers to fulfilling the needs of the customers whereas efficiency refers to the utilization of resources economically. Gimenez et al., (2012) argued that the firm performance should be measured in three dimensions.

The first type of performance is related to overall business performance, the second type of performance is related to efficiency, and the third type of performance is related to effectiveness (Gimenez et al., 2012). In this thesis, all three performance measures: business performance, efficiency, and effectiveness will be used to measure the outcome of an agile supply chain strategy. The business performance will include both the market-related as well as financial dimensions. Cost performance will be used to measure the efficiency of the firm. Effectiveness dimension will include how the firm has performed on quality, delivery, and flexibility. The operationalization of all the performance dimensions is detailed in chapter 4.

2.8 Contingency Theory

The statement that "TQM is in danger of being oversold, inappropriately implemented, and ineffective" highlights the perils associated with a universal solution for change movements in management (Sitkin et al., 1994, pg. 538). To avoid the failure of 'one size fits all' approach, scholars have argued that contingency theory (CT) can be an important theoretical lens to get insights about the organization (Sousa & Voss, 2008), because there is no 'one best way to manage the organization (Tosi & Slocum, 1984). For example, the operations management (OM) field has been intrigued by new management (manufacturing) practices and have been touted as the panacea to achieve superior performance (Sousa & Voss, 2008). However, the mixed findings of these new management practices have cast doubt on their ' one size fits all' notion because the mixed findings may stem from missing out the contingency variables (Sousa & Voss, 2008). According to CT, the organization's structure and processes are contingent on the environment in which they operate (Flynn et al., 2010), and a fit between organizational characteristics and contingencies will lead to higher performance (Donaldson, 2001).

The organization can be viewed as a system having various interrelated components and the central question in any system is the congruence among various elements of the system, because it influences the effectiveness of the organization (Nadler & Tushman, 1980). Fit, which refers to "the degree to which the needs, demands, goals, objectives, and/or structures of one component are consistent with the needs, demands, goals, objectives, and/or structures of another component", is measure of congruence and higher the congruence ,higher the effectiveness of the organization (Nadler & Tushman, 1980, pg. 45). Also, the organizations change their characteristics as the contingencies change, and therefore, CT reflects both the fit and adaptability nature of the organization (Donaldson, 2001).

CT theory can contribute to both theory and practice because it allows for grouping based on context by using the CT variables, which in turn can help the organizations to change its internal design or to respond accordingly (Sousa & Voss, 2008). CT argues that performance of an organization is a function of congruence between various elements of an organization such as 'structure, people, technology, strategy and culture'(Wiengarten et al., 2013, pg. 32).

The survival of the organization depends on the adaption of the organization with respect to its environment (Duncan, 1972). The environment of the organization includes both the physical and social factors and can be divided into the internal and external environment (Duncan, 1972). The operations management literature, in lines with CT literature, views environment from two perspectives:- internal and external (Chavez et al., 2017; Spina et al., 2002). For instance, the external environment refers to uncertainty in firms external environment such as competitive pressure, and regulations (Chavez et al., 2017), whereas internal environment of the organization can be strategic orientation, infrastructure, and culture (Spina et al., 2002). Most of the studies on contingency theory have focused more on variables such as

uncertainty and technology (physical factors), and future studies should include other contingency variables to understand the phenomenon better (Ketokivi, 2006).

This thesis includes supply chain strategy as one of the construct and researchers have argued that any study, which includes strategy, should include a contingency variable. For this thesis, the focus is on both the internal and external environment of the organization, and strategic integration, internal integration and environmental uncertainty will be used as contingency variables. For instance, strategic integration will be used to understand the moderating effect of strategic integration on the relationship between supply chain strategy and operational capability (MCC). Also, environmental uncertainty will be used to understand its moderating effect on the relationship between MCC and firm performance. Also, internal integration will be used to understand the moderating effect of internal integration on the relationship between OA and firm performance.

2.9 Knowledge-Based View

Knowledge is a " highly contentious concept," due to difficulty in articulating about the knowledge as well as the different forms of knowledge (Spender, 1996). Despite this difficulty, the knowledge-based movement has gained momentum, especially in the strategic field. This in part may be attributed to learning, which is the foundation of 'knowledge-based thinking,' because learning allows the actors of the organization to change their behavior based on new information that will lead to much-improved performance, most often if not always (Eisenhardt & Santos, 2002). Although knowledge has received much attention in the management field, research based on knowledge is sparse in the supply chain domain, which is evident in the following statement by Hult et al.,(2006, pg. 458), "The lack of attention to the link between knowledge (as an intangible resource) and supply chain outcomes is unfortunate."

Two perspectives can be drawn from a knowledge-based view. From the first perspective, the knowledge-based view is an extension of the resource-based view (RBV). According to RBV, firms with resources and capabilities that have VRIN (valuable, rare, inimitable and non-substitutable) qualities will allow them to achieve competitive advantage (Barney, 1991; Wernerfelt, 1984). Resources are assets or factor of production (tangible and intangible), and the organization has some form of control over them (Helfat & Peteraf, 2003). Hult et al., (2006) described knowledge as an intangible resource and explained how knowledge has the VRIN attribute that creates ' asymmetries' among firms (Menor et al., 2007) that creates value for the organization (Hult et al., 2006). The role of knowledge to create comparative advantage is highlighted in the following statement by Cyert et al., (1993, pg.57) , "*It is the existence of knowledge of internal production techniques or external opportunities in the hands of a small number of firms that creates the market imperfections necessary to generate rents for the firm. Put another way; it is the proprietary knowledge that creates a comparative advantage for the firm.*" On similar lines, other scholars have highlighted the importance of knowledge as a resource that can be utilized by the organization to outperform their competitors (Craighead et al., 2009; Hult et al., 2004; Paiva et al., 2008). According to this perspective, knowledge is an intermediate outcome that the organization should possess to achieve competitive advantage.

According to the second perspective, the emphasis is on the process view of knowledge or in other words, integration, and creation of knowledge by the organization (Grant, 1996; Huber, 1991; Kogut & Zander, 1992; Nonaka, 1994; Spender, 1996). Also, the scholars have argued that the mechanism of knowing or learning is as critical as the content itself, i.e., the knowledge (Spender & Grant, 1996). For example, Kogut &Zander (1992) proposed an alternative argument on the existence of the firms based on the knowledge. They argued that

firms are better than the market regarding integration and creation of knowledge, and the organization is a mechanism for sharing of knowledge as well as the creation of new knowledge. Furthermore, knowledge resides within an individual and social interaction facilitates the combination of knowledge by providing a platform for the organization to grow (Kogut & Zander, 1992). Similarly, Grant (1996) articulated that the organization is as an ‘ institution’ for integrating and production of knowledge and leading role of management should be to establish a mechanism for integration of knowledge. Knowledge is “the most important and complex means of value creation” (Grant, 1996, pg. 111). Knowledge-based view assumes that both the input and output resource is the knowledge and transferability, capacity for aggregation and appropriability are three characteristics of knowledge that will lead to competitive advantage and integration is vital in enhancing these three attribute of knowledge (Grant, 1996).

Nonaka (1994) also highlighted the role of the organization in knowledge formulation and augmentation. He argued that information processing and knowledge creation are two distinct things, wherein the former focuses on problem-solving, and the latter focuses on the output of problem-solving or in other words knowledge. He also conceded the fact that individuals and organization hold knowledge and they are critical in creating knowledge at the organization level.

Nonaka (1994) divided the knowledge in explicit and tacit knowledge and proposed four ways of knowledge creation: tacit to tacit, explicit to explicit, tacit to explicit and explicit to tacit. The organization can provide a forum regarding socialization, combination, externalization, and internalization that will create a ‘spiral of knowledge’ within an organization (Nonaka, 1994). Huber (1991), although use information and knowledge as interchangeable terms, argued that there are four-steps of knowledge creation and they are-: knowledge acquisition, information

distribution, interpretation and organization memory. He also stated that the information distribution, a key construct for new knowledge creation, is under-explored. In today's business environment knowledge is a crucial component of development that creates a need for more focus on the knowledge creation process and its role in creating value for the organizations (Nonaka, 1994). Accordingly, this study is proposing that internal integration is a knowledge integration and knowledge creating mechanism. Based on this argument, this research will examine the complementary role of internal integration to better understand the relationship between OA and four dimensions of operational performance.

2.10 Strategy- Structure – Performance Paradigm

Strategy- Structure -Performance (SSP) paradigm has become a dominant theoretical lens in strategic research (Jones & Hill, 1988; Wasserman, 2008). According to this paradigm, strategy and structure alone are not antecedents of performance, but it is the alignment of strategy and structure that will lead to the superior performance for the organizations (Wasserman, 2008). SSP paradigm reflects the concept of fit among strategy, structure and management processes of an organization, where a fit is defined as, "a process as well as a state—a dynamic search that seeks to align the organization with its environment and to arrange resources internally in support of that alignment. In practical terms, the basic alignment mechanism is a strategy, and the internal arrangements are organization structure and management processes" (Miles & Snow, 1984, pg. 11). The fit between strategy and structure will lead to better performance for the organization (Habib & Victor, 1991) and if organizations can attain an early fit, they are considered as ' Hall of Fame status' because these organizations keep performing better on a regular basis (Miles & Snow, 1984).

The strategy establishes the goals or objectives of the firm, whereas performance reflects the degree of achievement of those objectives and SSP paradigm reflects this performance aspect that emanates due to fit between the choice of strategy and structure of the organization (Defee & Stank, 2005). The strategy reflects the orientation path a firm will choose to compete, and structure portrays the distribution of resources to create capabilities, which will lead to improvement in performance (Stank et al., 2005).In this thesis, an agile supply chain strategy reflects a prior goal and objective of the firm's supply chain. The structure is referred to action and behavior of the firm (Patel et al., 2013) to fulfill the objective of firm's supply chain strategy, which is reflected in the capabilities of the firm. Supply chain strategy can provide a differential advantage through supply chain capabilities (Defee & Stank, 2005). Accordingly, the SSP paradigm will provide the theoretical support for investigating the relationship among agile supply chain strategy, MCC, OA, and firm performance.

Chapter 3

3.1 Research Hypotheses and Theoretical Model

The literature review in chapter 2 provides a background of all constructs of interest in this research. Also, the theoretical background from chapter 2 will be used as a theoretical lens to establish the relationship among the constructs of interest to investigate the research questions proposed in chapter 1. In this chapter, two separate theoretical models are developed along with proposed research hypotheses.

3.2 Research Model 1

In research model 1, the hypothesis between agile supply chain strategy and mass customization capability (MCC) is developed. Also, hypotheses showing an association between MCC and multiple dimensions of performance is delineated. Moreover, it has been proposed that MCC mediates the relationship between agile supply chain strategy and performance. Furthermore, hypotheses related to the moderating role of strategic integration and environmental uncertainty are developed in model1.

3.2.1 Agile Supply Chain Strategy and Mass Customization Capability (MCC)

Peng et al., (2008) argued that operations managers should have an understanding of operations and business strategy. Accordingly, this will help the firm to build operations capabilities that are in sync with the goal of their operations strategy (Peng et al., 2008). Applying the above argument to supply chain strategy implies that firms need to develop capabilities that support the goals of their supply chain strategy. For instance, one of the primary goals of the agile supply chain is to meet varying customer demands in a speedy manner (Qi et al.,2017). MCC will help realize this goal because MCC allows the firm to manufacture products to meet the unique requirement of the customers, and that too in a timely and cost-effective

manner (Huang et al., 2008; Tu et al., 2001). Also, agile supply chain focuses on how to reduce production lead times and increase customer service level (Swafford et al.,2006). MCC is characterized by the use of standardized components and platform (Wang et al.,2016) that allows for repetition in production (Jiao et al., 2003). The standardization and repetition will help the firm to reduce design and production cost and also increase the flexibility and responsiveness (Wang et al., 2016). Moreover, the repetition helps the firm to achieve the economies of scale and thereby reducing cost and lead time (Jiao et al., 2003). Creation of value for customers and excelling during change and uncertainty are another strategic goals of agility (Devor et al.,1997), and MCC helps the organization to create value for customers (Jiao et al., 2003)) and to thrive in a dynamic environment (Jitpaiboon et al., 2013).

Agile supply chain focuses on understanding the market and customer requirement (Vonderembse et al., 2006), and MCC can facilitate the increase in the knowledge stock of firm ’s customers base and preferences because customers are more inclined to share information with mass customizers (Zhang et al., 2015). Furthermore, due to increase in knowledge stock of customers specific information, firms can provide a variety of products to customers as per their need by incorporating customer requirements both in product design and production processes (Zhang et al., 2015). The main elements of MCC are rapid response, cost effectiveness, and volume effectiveness, thereby increasing product variety, quality, and providing value to customers (Tu et al., 2001), thus enabling the organization to achieve the goal of flexibility and quick response (Qrunfleh & Tarafdar, 2014). The empirical studies also suggest that MCC of a firm improves delivery (Wang et al., 2016), customer satisfaction (Tu et al., 2001), product innovation (Zhang et al., 2015), business performance (Jitpaiboon et al., 2013), and operational performance and customer satisfaction (Liu et al., 2012). The findings of the above empirical

studies indicate that MCC of the firm helps the firm to achieve the objectives of the agile supply chain.

Customer effectiveness and efficiency are two objectives associated with the agile supply chain strategy (Gligor et al., 2015). Customer effectiveness is related to the fulfillment of customers related objectives (Gligor et al., 2015), whereas efficiency is related to the improvement in output to input ratio (Priem & Butler, 2001). In comparison to lean supply chain strategy, Lee (2004) argued that agile supply chain can meet the customer demands quickly and in a cost-efficient way. Similarly, other scholars have suggested that both effectiveness and efficiency are the benefits associated with agile supply chain strategy (Swafford et al., 2006; Tseng & Lin, 2011). MCC has the qualities of ambidexterity that enables an organization to achieve both the goals of agile supply chain strategy: - efficiency and effectiveness. Fisher (1997), in his seminal paper on supply chain strategies, provided an example of a company named 'National Bicycle' in Japan and how mass customization helps the company to respond quickly and cost-effectively, which are the characteristics of the agile supply chain. Based on the above theoretical arguments and empirical evidence, the following hypothesis is put forth:

H1: *The level of emphasis on an agile supply chain strategy is positively associated to the extent to which MCC is pursued.*

.3.2.2 Mass Customization Capability (MCC) and Performance

Despite the theoretical underpinning about the positive influence of MCC on performance, there is a lack of empirical evidence to support this relationship (Liu et al., 2012). MCC is firm operational capability and capabilities are firm-specific and are developed internally that makes them inimitable and valuable resources (Swink & Hegarty, 1998). MCC has these characteristics which can provide a competitive advantage to the organization (Liu et

al., 2012). In case of MCC, Feitzinger & Lee (1997) argued that MCC is not a "financially risky strategy," and MCC can satisfy the customer as well as increase the financial performance of the firm. For example, HP pursued the MCC and HP was able to deliver the products quickly and at a low cost to its customers (Feitzinger & Lee, 1997). MCC creates new knowledge, and this new knowledge can reduce redundancies and refine existing ways of doing things at the organization, thus contribute towards efficiency (Kotha, 1995). Furthermore, the knowledge created through MCC will increase response to customer demands, thereby improve effectiveness and create more value for the customers (Fugate et al.,2009). Kotha (1995) suggested that MCC helps in reducing finished goods inventory and work in process inventory, waste in the value chain, and product obsolescence. Accordingly, the outcome is lower cost and more flexibility. Some scholars have argued that MC increases the cost for the firm, but the benefits of MCC are much more than the cost associated with it (Kotha, 1995). Infact, Piller et al., (2004) argued that MCC result in cost saving due to reduction in uncertainty, more precise information about the market. The three core component of MCC:- cost-effectiveness, volume effectiveness, and responsive effectiveness, helps the firm to reduce cost, increase flexibility in production volume, and decrease response time (Tu et al., 2001).

MCC allows the firm to change its resources to cater to the need of the customers that will result in improved operational performance (Ahmad et al.,2010). The firm pursuing MC focuses on " zero mistakes" in all the value-creating processes because errors can have a detrimental impact on customers confidence (Kotha, 1996). The 'zero mistake' environment will act as an enabler to reduce errors/mistake which in turn will reduce rework, thereby reducing cost and improving the quality. Some empirical studies result also suggest the MCC has a positive effect on the performance. For example, scholars have found a positive relationship

between MCC and operational performance (Kortmann et al.,2014), delivery (Wang et al., 2016), and plant performance (Ahmad et al., 2010; Liu et al., 2012). However, most of these studies have investigated the aggregate measure of operational performance and does not provide a holistic view of the relationship between MCC and performance. Moreover, the researchers have also argued that if the performance variable is multidimensional, then studies should investigate the relationship between antecedents and each dimension of performance (Ketokivi & Schroeder, 2004). Also, it is beneficial to show the unique impact of MCC on each dimension of performance so that practitioners are better equipped for the deployment of scarce resources to develop capabilities that will support their performance objectives.

Similarly, MCC can also enhance the business performance of the firm because a firm can charge a higher price by providing a customized solution (Piller et al., 2004)). For example, Piller et al., (2004) stated that Adidas has more customization as compared to Nike, therefore Adidas charges more to customers (up to 50%) as compared to Nike (between 5% and 10%). Tu et al., (2001) found that MCC enhances customer satisfaction. Customer satisfaction increases " *loyalty for current customers, reduced price elasticities, insulation of current customers from competitive efforts, lower costs of future transactions, reduced failure costs, lower costs of attracting new customers, and an enhanced reputation for the firm*" (Anderson et al.,1994, pg. 55), which will help the firm to improve its business performance. Kay (1993) studied one dairy firm to investigate the impact of mass customization, and he observed that diary firm was able to achieve twenty percent return on its investment. Similarly, Jitpaiboon et al., (2013) in their empirical study found a positive relationship between MC and firm performance. Based on the above arguments, the following hypotheses are proposed:

H2: *There is a direct and positive relationship between a firm's MCC and the firm's cost performance.*

H3: *There is a direct and positive relationship between a firm's MCC and the firm's quality performance.*

H4: *There is a direct and positive relationship between a firm's MCC and the firm's delivery performance.*

H5: *There is a direct and positive relationship between a firm's MCC and the firm's flexibility performance.*

H6: *There is a direct and positive relationship between a firm's MCC and the firm's business performance.*

3.2.3 Main Effect of Strategic Integration (SI)

Strategic integration 'create paths' that will lead to the improved operational performance of the organization (Swink et al., 2005). In this thesis, I am arguing that MCC is the path that will be created by strategic integration or in other words, strategic integration acts as an antecedent of the firm's MCC. Strategic integration activities integrate various inputs such as market information that can guide the actions of all departments of a firm towards achieving the firm goal (Ralston et al., 2015). For example, the strategic integration enables the firm to develop a relationship with suppliers and customers (Ralston et al., 2015), which in turn helps the firm to develop MCC (Lai et al.,2012). Swink et al., (2005) argued that strategic integration is a crucial ingredient for the development of the organizational capabilities because it enhances the alignment in decision making such as goal setting and resource utilization (Swink et al., 2007). Valuable interaction among decision makers and other members of the organization allows the manufacturing firm to understand the needs of the customer and prepare them to respond by

directing the resources to develop capabilities that can help the firm to fulfill the changing requirements of the customers (Swink et al., 2007). Moreover, strategic integration reduces complexity by emphasizing the appropriate manufacturing capability that serves the objective of the organization (Swink et al., 2007)) as strategic integration allows the firm to pinpoint the capabilities with their benefit and limitations in achieving the goal of the organization (Ralston et al., 2015). For instance, Ralston et al., (2015) argued that strategic integration helps the firm to develop external capabilities based on the limitation of internal capabilities identified by strategic integration activities and they found empirical support for the argument that strategic integration has a positive influence of supplier and customer integration. Based on the above theoretical and empirical arguments, the following hypothesis is proposed:

H7: *Strategic integration (SI) of the firm is positively related to the MCC of the firm.*

3.2.4 Mediation Role of Mass Customization Capability (MCC)

The strategy -structure- performance (SSP) paradigm is the theoretical basis to advance the argument among strategy, capability, and performance. According to SSP perspective, strategic choice (strategy) is one of the vital element of organizational structure and processes (Miles and Snow, 1978). The fit among strategy, structure, and processes is critical for organizational success wherein fit is*" a process as well as a state—a dynamic search that seeks to align the organization with its environment and to arrange resources internally in support of that alignment*" (Miles & Snow, 1984, pg 11). The arrangement of resources is a part of the structure that is related to allocation of resources to develop supply chain capabilities (Stank et al.,2005). Researchers have argued that strategic planning of an organization can be analyzed through the theoretical lens of SSP framework (Galunic & Eisenhardt, 1994). Strategic planning involves three steps: ends, ways and mean (Hayes, 1985). From operations and supply chain

perspective, ends is related to performance outcome, ways are related to competitive priorities or strategy, and means are the development of operational capabilities (Peng et al., 2011). Thus, the central role of managers is to identify and develop operational capabilities that will help to achieve the desired outcome (performance) as specified in the ways(strategy or competitive priorities) of the organization (Peng et al., 2011). Peng et al.,(2011) found that manufacturing capabilities are critical means to realize the content of operations strategy. Similarly, Patel et al., (2013) also found empirical support that strategy is antecedent to the structure and the firm needs structure to implement its strategy because structure, reflected in capabilities, act as 'generative means' (Swink et al.,2007) by which supply chain strategy of the firm influences the performance. Based on theoretical and empirical findings, the following hypotheses are proposed:

H8a*: Mass customization capability (MCC) of the firm will mediate the relationship between agile supply chain strategy and cost performance.*

H8b*: Mass customization capability (MCC) of the firm will mediate the relationship between agile supply chain strategy and quality performance.*

H8c*: Mass customization capability (MCC) of the firm will mediate the relationship between agile supply chain strategy and delivery performance.*

H8d*: Mass customization capability (MCC) of the firm will mediate the relationship between agile supply chain strategy and flexibility performance.*

H8e*: Mass customization capability of the firm (MCC) will mediate the relationship between agile supply chain strategy and business performance.*

3.2.5 Moderating Role of Environmental Uncertainty (EU)

The studies in organization theory shed light on organization structure and environment (Pagell & Krause, 2004). For example, the influence of environmental uncertainty on the relationship between MCC and firm performance can be explained through the theoretical lens of contingency theory (CT). According to CT, the match between the organization structure and environment will lead to better performance (Bluedorn, 1993). Applying CT in the context of MCC, this study argues that the relationship between MCC and operational and business performance will be stronger when environmental uncertainty is high. Compared to a stable environment, a dynamic environment requires manufacturers to alter its production processes quickly (Azadegan et al., 2013). MCC, through practices such as effective process implementation, helps the firm to innovate both in product and process with no penalty in cost (Huang et al., 2008). Product innovation is critical to fulfilling the changing taste of customer and process innovation facilitate the product innovation and both leads to better business performance in a dynamic environment (Prajogo, 2014). Closeness to the customer, another key practice of MCC (Tu et al., 2004) enhances the ability of the organization to understand the market opportunities (McCarthy, 2004), a key to surviving in the uncertain environment. This will the equip the manufacturers to make decisions such as attributes and price of products so that customers requirements are met at a lower cost and a faster speed (Zhang et al., 2015).

Some authors have argued MCC is not a universal strategy and will not reap the benefit in the markets, where the requirement of customization is not high. For instance, commodity markets such as wheat and oil, which resemble stable environment and implementation of MCC is an expensive proposition in these markets (Pine et al., 1993). They further differentiated between continuous improvement and MCC and argued that continuous improvement is

beneficial in the market where demand is stable and predictable, and MCC is beneficial in the markets characterized by short product lifecycle and changing needs of the customers. Moreover, the dynamic environment opens up new markets, and firms need products to cater to these new markets (Prajogo, 2014) and MCC, through its ability in producing innovative products (Zhang et al., 2015), allows firms to capture and fulfill the customer's needs ,therefore appropriating more rent (Prajogo, 2014). The dynamic environment is characterized by less predictability, and ambiguity (Azadegan et al., 2013). But MCC enables a firm to overcome these problems imposed by external environment by enabling a fit between the manufacturer's capabilities and market requirement through engagement with the customers, developing new products and services, which in turn will result in better resource utilization, increase in customer satisfaction and business performance (Jiao et al., 2003). The organization with MC capability generally have the organic organizational structure (Huang et al., 2010), implements time-based manufacturing practices (Tu et al., 2001), and integration with suppliers and customers (Jitpaiboon et al., 2009). These practices improves the information sharing not only within the organization but with external partners, which enables the organization to develop quick responses based on accurate forecast and balance supply and demand (Wang et al., 2016) ,which is one of the critical element of the firm's actions in a dynamic environment (Patel et al., 2013). Taken together, the following hypotheses are proposed:

H9a: *Environmental uncertainty will moderate the relationship between mass customization capability and cost such that under the high levels of environmental uncertainty, the impact of mass customization capability on cost will be stronger than under the low levels of environmental uncertainty.*

H9b: *Environmental uncertainty will moderate the relationship between mass customization capability and quality such that under the high levels of environmental uncertainty, the impact of mass customization capability on quality will be stronger than under the low levels of environmental uncertainty.*

H9c: *Environmental uncertainty will moderate the relationship between mass customization capability and delivery such that under the high levels of environmental uncertainty, the impact of mass customization capability on delivery will be stronger than under the low levels of environmental uncertainty.*

H9d*: Environmental Uncertainty will moderate the relationship between mass customization capability and flexibility such that under the high levels of environmental uncertainty, the impact of mass customization capability on flexibility will be stronger than under the low levels of environmental uncertainty.*

H9e: *Environmental Uncertainty will moderate the relationship between mass customization capability and business performance such that under the high levels of environmental uncertainty, the impact of mass customization capability on the business performance will be stronger than under the low levels of environmental uncertainty.*

3.2.6 Moderating Role of Strategic Integration (SI)

Strategic integration improves joint strategic planning and working relationship among various functional groups, which in turn will facilitate information sharing and increase in knowledge stock (Narasimhan et al., 2010). Increased knowledge base within the organization enables the organizations to develop means (capabilities) to support its chosen strategy. Boyer and Lewis (2002) in their study observed that employees at different levels have a different

opinion about the content of manufacturing strategy which may impact the decisions to support the manufacturing strategy. Strategy integration will develop strategy consensus that can foster the development of appropriate capabilities to support the content of the strategy (Boyer & Lewis, 2002). The same logic when applied to supply chain strategy implies that strategic integration will facilitate the decisions (structural and infrastructural) such as investment in appropriate technology and supply chain practices to develop MCC to achieve the goal of the supply chain strategy. Strategy integration will help the members of the entire organization to pull in the same direction that will foster the development of appropriate capabilities corresponding to its strategy, and there will be a better fit between intended strategy and capabilities (Boyer & McDermott, 1999). For example, America West and Southwest airlines have the same strategy, but America West was not able to develop capabilities that support its strategy, and the result was poor performance (Boyer & McDermott, 1999). It is the people of the organization who have to decide to support its organizational strategies such as supply chain strategy, and strategy integration provides a shared understanding of goals of the strategy (Boyer & McDermott, 1999). The shared understanding allows the decision makers to make a consistent decision to support the objective of their supply chain strategy. Therefore, the following hypothesis is put forth:

H10: *Strategic integration (SI) will positively moderate the relationship between agile supply chain strategy and mass customization capability (MCC).*

3.2.7 Summary of Research model 1

A theoretical model showing the relationship between an agile supply chain strategy, mass customization capability, strategic integration, environmental uncertainty, operational and business performance is illustrated in figure 1.

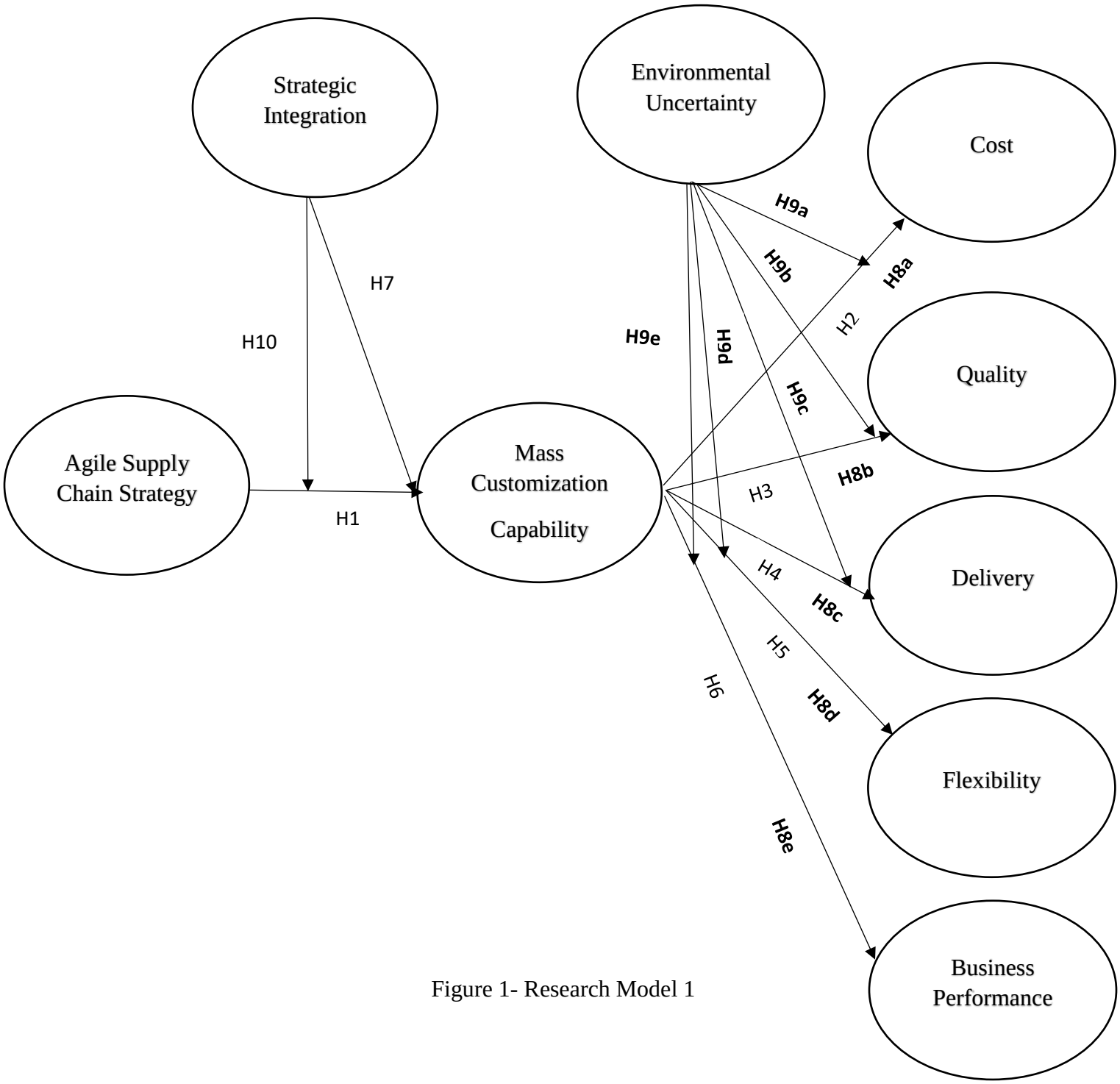

Figure 1- Research Model 1

Control Variables in the Model (not shown)- Size and Age of the firm
H8a, H8b, H8c, H8d, and H8e are mediation hypothesis
H9a, H9b, H9c, H9d H9e, and H10 are moderation hypotheses

3.3 Research Model 2

First, this research model examines the relationship between agile supply chain strategy and operational ambidexterity, and between operational ambidexterity and cost, quality, delivery, and flexibility performance of the firm. Second, this theoretical model investigates the mediating role of operational ambidexterity between agile supply chain strategy and four operational performance dimensions of the firm (cost, quality, delivery, and flexibility). Finally, this model examines the moderating role of internal integration between operational ambidexterity and multiple dimensions of the operational performance of the firm (cost, quality, delivery, and flexibility).

3.3.1 Agile Supply Chain Strategy and Operational Ambidexterity (OA)

Agile supply chain approach is appropriate during high environmental uncertainty (Christopher et al., 2006), and operational ambidexterity can help the firm to increase its response during uncertain environment (Patel et al., 2012). Ambidextrous firms pursue both exploration and exploitation activities simultaneously because exploration or exploitation alone is not sufficient in the dynamic business environment (Kristal et al., 2010). The rationale behind above argument is that ambidexterity capability enhances flexibility through fine-tuning of current resources and creating new competencies, and thus resulting into a flexible response (Patel et al., 2012), which is one of the objectives of agile supply chain strategy (Qrunfleh & Tarafdar, 2014). For instance, Mason-Jones et al., (2000), through the case study of US carpetmakers who were pursuing agility in their supply chain, found that elimination of waste along with innovative processes helped the firms to reduce not only lead time but also the cost. This suggests that the firms were practicing both exploitation and exploration activities that helped them in improving performance.

Agile supply chain goal is not only to meet the demands of existing customers but also to exploit future market opportunities (Brown & Bessant, 2003). This study argues that operational ambidexterity enables the firm to achieve this objective of agile supply chain strategy because exploration helps the firm to meet latent requirements of the customers whereas exploitation helps to meet the current needs of the customers (Li et al., 2008).

The literature on supply chain agility suggests that agile supply chain focuses on both efficiency and effectiveness (Gligor et al., 2015; Lee, 2004), and operational ambidexterity helps the organizations to improve not only efficiency but also the response (Patel et al., 2012). Exploration is associated with second-order learning, whereas exploitation is associated with first order learning (Su et al., 2014). Adler et al., (1999) found that NUMMI plant was incorporating both first order and second order learning and was able to excel on both efficiency and effectiveness. High level of operational ambidexterity helps firms to pursue both incremental and radical form of innovation which in turns allows firms to extend their product mix and product lines (Kortmann et al., 2014), thus addressing the flexibility and responsiveness aspect of agility. Moreover, ambidexterity helps the firm to create " dynamics" in its knowledge base (Kristal et al., 2010) that can help the firm to change its supply chain operations quickly. Therefore, the following hypothesis is put forth:

H1: *The level of emphasis on an agile supply chain strategy is positively associated to the extent to which operational ambidexterity is pursued*.

3.3.2 Operational Ambidexterity (OA) and Performance

March (1991)in his seminal article stated the too much focus on either exploration or exploitation would not benefit the organization as it may create a learning trap (Levinthal & March, 1993). Too much focus on exploitation may lead to success trap whereas too much

emphasis on exploration may lead to failure trap (Levinthal & March, 1993). March (1991, pg. 71) emphasized that "maintaining an appropriate balance between exploration and exploitation is a primary factor in system survival and prosperity." Ambidexterity, which is simultaneously pursuing both exploration and exploitative activities, is the key to achieve long-term success (Tushman & O'Reilly, 1996b). In their article, they gave an example of how firms such as HP, Johnson & Johnson, and Asea Brown Boveri were more successful by pursuing ambidexterity. Katila & Ahuja (2002) argued that pursuing exploration and exploitation increases the absorptive capacity of the firm, which facilitates the implementation of manufacturing practices (Tu et al., 2006), which in turn leads to improved operational performance (MacKelprang & Nair, 2010). Ambidexterity helps the firm to increase its internal competencies as well as access to wide variety of external supply chain resources that allows the firm to compete on multiple dimensions such as "price wars, quality wars, flexibility wars, etc." (Kristal et al., 2010).

Repeated use of existing knowledge will facilitate the creation of new knowledge that will help the firm to create new products, whereas new knowledge will help to improve the efficiency of current exploitative processes (Cao et al., 2009). For example, United Parcel Service was able to improve the efficiency of its core business (parcel delivery) by providing a new and creative supply chain solution to its customers (Cao et al., 2009). Exploration increases the innovation in products and services whereas exploitation increases the refinement of existing products and services (Im & Rai, 2008), which in turn improves the performance of the firm. Based on the above, the following hypothesis is purposed:

H2: *There is a direct and positive relationship between a firm's operational ambidexterity and the firm's cost performance.*

H3: *There is a direct and positive relationship between a firm's operational ambidexterity and the firm's quality performance.*

H4: *There is a direct and positive relationship between a firm's operational ambidexterity and the firm's delivery performance.*

H5: *There is a direct and positive relationship between a firm's operational ambidexterity and the firm's flexibility performance.*

3.3.3 Mediating Role of Operational Ambidexterity (OA)

Researchers have argued that strategic planning of an organization can be analyzed by using the theoretical lens of SSP framework (Galunic & Eisenhardt, 1994). According to SSP perspective, strategic choice (strategy) is one of the critical element of organizational structure and processes (Miles & Snow 1978). The fit among strategy, structure, and processes is vital for organizational success wherein fit is" a process as well as a state—a dynamic search that seeks to align the organization with its environment and to arrange resources internally in support of that alignment" (Miles & Snow, 1984, pg. 11).

Strategic planning generally involves three steps: ends, ways and mean (Hayes, 1985). Ends are related to performance outcome; ways are related to competitive priorities or strategy and means are the development of operational capabilities (Peng et al., 2011). Hence, the leading role of managers is to identify and develop operational capabilities that will help to achieve the desired outcomes as specified in the ways (strategy or competitive priorities) of the organization (Peng et al., 2011). The goal of agile supply chain strategy is to fulfill the changing requirement of the customers quickly in an efficient way, and operational ambidexterity of the firm is mean to meet the objective of its supply chain strategy. Peng et al., (2011) found that manufacturing capabilities are critical means to realize the content of the operations strategy.

Also, Patel et al., (2013) found empirical support that strategy is antecedent to the structure and firm need structure to implement its strategy because structure, reflected in capabilities, act as 'generative means' (Swink et al., 2007) through which supply chain strategy of the firm influences the performance. Based on theoretical and empirical findings, the following hypotheses are proposed:

H6a: *Operational ambidexterity of the firm will mediate the relationship between agile supply chain strategy and cost performance.*

H6b: *Operational ambidexterity of the firm will mediate the relationship between agile supply chain strategy and quality performance.*

H6c*: Operational ambidexterity of the firm will mediate the relationship between agile supply chain strategy and delivery performance.*

H6d: *Operational ambidexterity of the firm will mediate the relationship between agile supply chain strategy and flexibility performance.*

3.3.4 Moderating Role of Internal Integration

Internal integration facilitates social interaction among the actors of the organization, and social interaction is a mechanism for the exchange of knowledge (Inkpen & Tsang, 2005). This exchange of knowledge will amplify the knowledge created through operational ambidexterity that will enhance the application of knowledge to improve the processes that will influence the efficiency or effectiveness performance of an organization. From the routine perspective, organizational routines facilitate the dissemination of knowledge, more specifically the tacit knowledge (Modi & Mabert, 2007). Routines are essential elements of an organization, and they are a temporal structure within an organization, enacted to achieve the organization's objectives (Feldman, 2000). Based on the above logic of routine, internal integration represents the

temporal structure that facilitates sharing of knowledge among members of the organization. The sharing of knowledge will help the firm to better utilize the strength of operational ambidexterity, and that will boost the impact of operational ambidexterity on cost efficiency and customer effectiveness. For example, the sharing of knowledge might help the actors of the organization to hone their skills on both the exploitive and explorative activities, thereby enhances the effectiveness of operational ambidexterity on both cost efficiency and customer effectiveness. Moreover, innovation creates a new form of ' information and knowledge' which can facilitate change in overall organization's knowledge system (Nonaka, 1994). Internal integration can be the tool that will be helpful in combining the knowledge from operational ambidexterity and disseminating that knowledge into the entire system of the organization, which might amplify the impact of operational ambidexterity on the performance.

Transferability, the capacity for aggregation and appropriability are three characteristics of knowledge that will create value for the organization (Grant, 1996). Internal integration is a mechanism that facilitates the transfer of knowledge due to communication and creating a common language. Communication is required to transfer explicit knowledge, and common language is essential for the transfer of tacit knowledge (Grant, 1996). From absorptive knowledge perspective (Cohen & Levinthal, 1990), internal integration will facilitate the accumulation of absorptive capacity by creating a common language because "efficiency of knowledge aggregation is greatly enhanced when knowledge can be expressed in terms of common language" (Grant, 1996, pg 111). It can be argued from knowledge base view that operational ambidexterity is knowledge and internal integration act as a mechanism to aggregate that knowledge, thus amplifying the influence of operational ambidexterity on the performance. Accordingly, the following hypotheses are proposed :

H7a: *Internal integration will moderate the relationship between operational ambidexterity and cost performance such that impact of operational ambidexterity on cost performance will higher at a high level of internal integration than at the low level of internal integration.*

H7b*: Internal integration will moderate the relationship between operational ambidexterity and quality performance such that impact of operational ambidexterity on quality performance will higher at a high level of internal integration than at the low level of internal integration.*

H7c: *Internal integration will moderate the relationship between operational ambidexterity and delivery performance such that impact of operational ambidexterity on delivery performance will higher at a high level of internal integration than at the low level of internal integration.*

H7d*: Internal integration will moderate the relationship between operational ambidexterity and flexibility performance such that impact of operational ambidexterity on flexibility performance will higher at a high level of internal integration than at the low level of internal integration.*

3.3.5 Summary of Research model 2

A theoretical model showing the relationship between an agile supply chain strategy, operational ambidexterity, internal integration, cost, quality, delivery and flexibility performance is illustrated in figure 2.

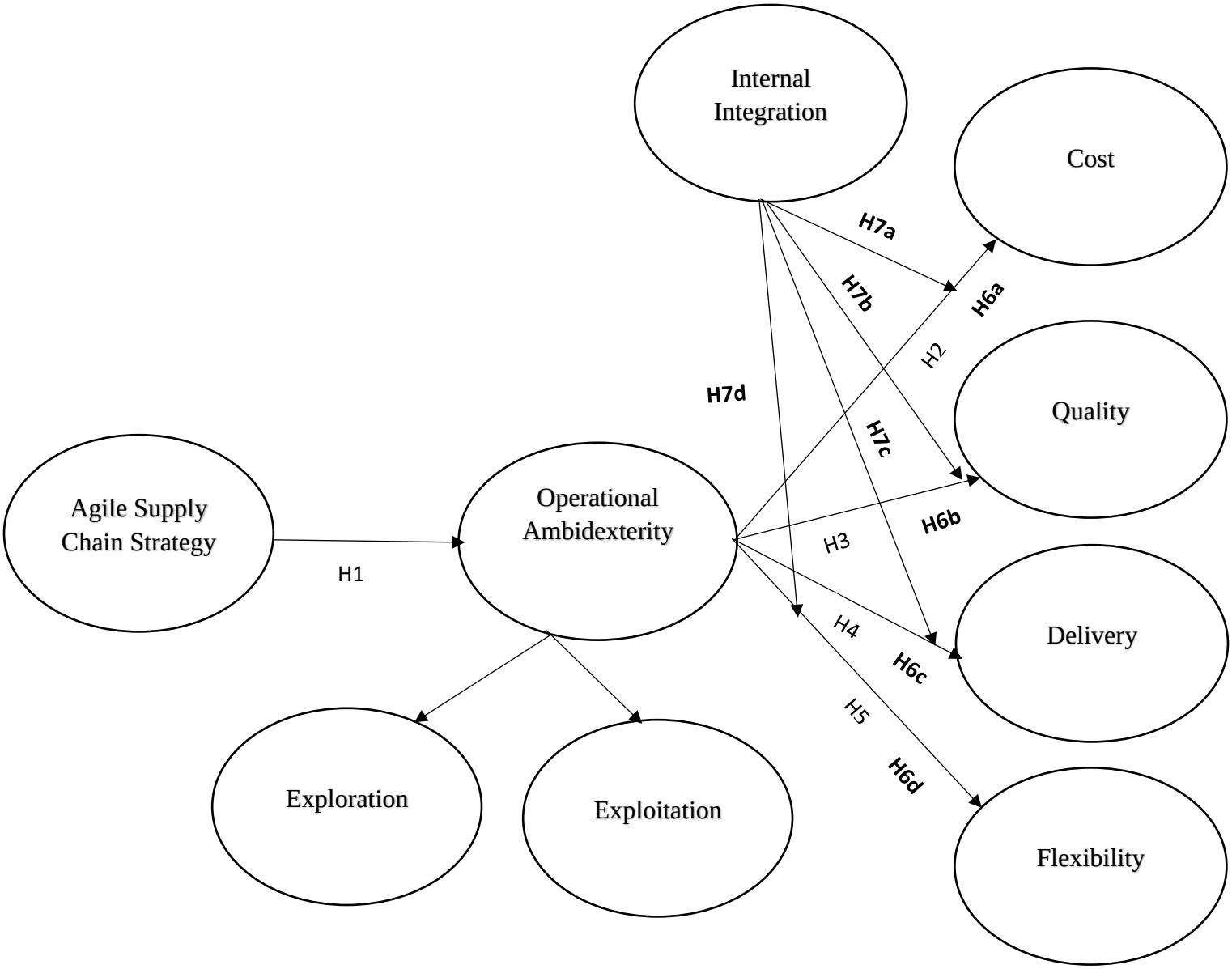

Figure 2- Research Model 2

Control Variables in the Model (not shown)- Size and Age of the firm
H6a, H6b, H6c, and H6d are mediation hypothesis
H7a, H7b, H7c, and H7d are moderation hypotheses

Chapter 4

4.1 Overview

The objective of this chapter is to test the hypotheses developed for two research models in chapter 3. First, questionnaire design and data collection method are discussed in this chapter. Second, psychometric properties and hypotheses testing for the first model are presented. Third, Model 2 is analyzed to test the hypotheses along with validity and reliability of the constructs. Finally, the results of both the models are summarized.

4.2 Questionnaire Design

All the measures used in this study were adapted from scales validated in the extant literature. The constructs, their items, and anchoring are discussed in the following section. The list of all the items along with their constructs is provided in table 2.

4.2.1 Agile Supply Chain Strategy

The items to measure agile supply chain strategy were adapted from the work of Qi et al.,(2017), and Qrunfleh & Tarafdar (2014). The respondents were asked to rate the importance of their firm's supply chain goal with respect to their firm's major product line on 7 points Likert scale (1- Not all important, 7- absolutely essential). In total, seven items were used to measure the importance of the focal firm supply chain objective regarding flexibility, adaptability and responsiveness.

4.2.2 Mass Customization Capability

Tu et al., (2001) developed the scale to measure the mass customization capability, and the scale has been validated in other studies (Huang et al., 2008, 2010; Liu et al., 2012; Kristal et al., 2010). In total, five items from Huang et al., (2008) were adapted to measure mass

customization capability. The 7- point Likert scale (1- strongly disagree and 7- strongly agree) was used to measure mass customization capability and respondents were asked to indicate the extent to which they agree on five items representing the mass customization capability.

4.2.3 Operational Ambidexterity

The item to measure both exploration and exploitation dimension were adapted from Patel et al., (2012) and Kortmann et al., (2014). In total six items were used to represent the exploration and exploitation dimension respectively. The six items of exploration reflect the search, experimentation practices and use of knowledge for the creation of new products and services. The six items of exploitation reflect the refinement practices and use of knowledge for the incremental improvements in existing products and services. The constructs of operational exploitation and exploration practices were captured on self-anchored, 7-point Likert-type scales, ranging from 1 = strongly disagree, to 7 = strongly agree.

4.2.4 Internal Integration

The items used to measure the internal integration represent the process within the firm that will foster information sharing and teamwork (Williams et al.,2013). The seven items were used to measure the internal integration, and all were adapted from Williams et al., (2013).The 7-point Likert scale (1- strongly disagree and 7- strongly agree) was used to measure the internal integration and respondents were asked to indicate the extent to which they agree on seven items representing the internal integration.

4.2.5 Strategic Integration

The items for strategic integration were adapted from Raltson et al., (2015) study. In total five items were used to measure the strategic integration of the firm. Participants were asked to

rate (1 = strongly disagree, 7 = strongly agree) their level of agreement with the four items representing the strategic integration.

4.2.6 Operational Performance

There is a consensus in operations and supply chain management literature that cost, quality, delivery, and flexibility are four critical dimensions of operational performance (Boyer & Lewis, 2002; Schmenner & Swink, 1998; Ward et al., 1998). To achieve low cost is a cause of concern for many firms (Ward et al., 1998). Lower production cost, lower inventory cost, offering a lower price to customers are some of the elements of cost performance. Cost efficiency allows the firm not only to lower the prices but also flexibility in prices as per the need of the marker (Swink et al., 2005). In this research, four items were used to measure the cost performance of the firm and these four items reflect not only lower production cost but also the ability to offer lower prices to the customers. All the four items were adapted from Wong et al., (2011).

Speed and reliability are two dimensions of delivery performance (Ward & Duray, 2000). Speed is related to the ability of the organization to deliver faster than its competitor, whereas reliability reflects the ability of the firm to deliver as per the requirement of the customer (Jacobs & Chase, 2016). Both the speed and reliability are essential to winning the orders (Ward et al., 1998). Four items were used to measure delivery, and all the items were adapted from the study of Wong et al., (2011) and Gligor et al., (2015).

The literature on quality performance has proposed multiple dimensions of the quality performance. For example, Garvin (1987) proposed eight dimensions of quality:- performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality. Similarly, Clark et al., (1992) argued that conformance quality and design quality are two

dimensions of the quality. Fynes et al., (2005) argued that external quality performance such as the satisfaction of the customer is also an essential dimension of quality because conformance and design quality are internal measures of quality. Accordingly, this research has used items that measure these three dimensions of quality. In total six items were used to measure the quality performance, and all the items were adapted from Ward et al., (1998), Wu et al., (2010), Zhang et al., (2012), and Zhang et al., (2014).

Similar to quality, flexibility also comprised of multiple dimensions. For example, Jacobs & Chase (2016) discussed two main dimensions of flexibility:- volume flexibility and product flexibility. Volume flexibility allows the firm to adjust the production based on the variability in demand, whereas product flexibility refers to providing a variety of products in a speedy manner (Jacobs & Chase, 2016). Swink et al., (2005), after reviewing the literature on flexibility, argued that process flexibility and new product flexibility are two dimensions of flexibility. These two dimensions of flexibility are similar to volume flexibility and product flexibility dimensions of Jacobs & Chase (2016). This study also concedes that there are two dimensions of flexibility and the items used to represent flexibility measures both volume and product flexibility. In total, six items were used to measure the firms' flexibility, and the items were adapted from the study of Ward et al., (1998), Boyer & Lewis (2002), and Wong et al., (2013). Respondents were asked to evaluate their firm’s performance with respect to their major competitors on 7- point Likert scale with 1(‘much worse) and 7(‘much better’) on all four dimensions of operational performance.

4.2.7 Business Performance

The business performance indicators were based on the study of Flynn et al., (2010) (2010) and Qi et al., (2011). In total nine indicators were used to measure both the market as well as financial performance. Respondents were asked to evaluate their firm's performance relative to their competitors on a 7-point Likert scale with 1 ('much worse') and 7 ('much better').

4.2.8 Environmental Uncertainty

Four indicator variables were used to measure the environmental uncertainty. These four variables measure the turbulent in the business environment in which the firm operates. Participants were asked to rate (1 = strongly disagree, 7 = strongly agree) the business environment of their respective market. The variables were taken from Ward & Duray (2000) and Zhang et al., (2012) studies.

4.2.9 Control Variables

Two control variables were used in this research: – the size of the firm and age of the firm. Size of the firm can influence the performance because of more resources and market power (Kristal et al., 2010). Size can also influence the operational capabilities. For example, Lin et al., (2007) argued that large firms can pursue both exploitation and exploration because large firms have more resource availability to devote to both types of practices. Also, firm size may influence the ability to process information and adapt accordingly, which might have an impact on the performance (Patel et al., 2012). Sales revenue of the firm was used as a proxy for the size of the firm. Moreover, age of the firm might influence the development of capabilities as well as the performance because older firms have established routines and norms (Patel et al., 2012).

Table 2 Indicators List

Construct	Item Code	Item
Agile Supply Chain Strategy	AS_1	Respond effectively to changing requirements of the design.
	AS_2	Respond quickly to customization requirements.
	AS_3	Handle changes in product design.
	AS_4	Maintain a higher capacity buffer to respond to a volatile market.
	AS_5	Select suppliers based on their performance on flexibility.
	AS_6	Select suppliers based on their performance on responsiveness.
	AS_7	Provide customers with personalized products.
Mass Customization Capability	MCC_1	We are highly capable of large-scale product customization.
	MCC_2	We can easily add significant product variety without increasing costs.
	MCC_3	Our set up costs, when changing from one product to another, are very low.
	MCC_4	We can customize products while maintaining high volume.
	MCC_5	We can add product variety without sacrificing quality.
Business Performance	BP_1	Return on Investment (ROI).
	BP_2	Return on Assets (ROA).
	BP_3	Return on Sales (ROS).
	BP_4	Market share.
	BP_5	Growth in market share.
	BP_6	Growth in sales.
	BP_7	Growth in return on investment (ROI).
	BP_8	Growth in return on asset (ROA).
	BP_9	Growth in profit.
Environmental Uncertainty	ENVIRN_1	The rate at which products and services become outdated in our industry is extremely high.
	ENVIRN_2	The rate of innovation of new products and services in our industry is extremely high.
	ENVIRN_3	The demand for our firm's products is unstable and unpredictable
	ENVIRN_4	The rate of innovation of new operating processes is extremely high.
Cost	COST_1	Produce products with low costs
	COST_2	Produce products with low inventory costs.
	COST_3	Produce products with low overhead costs
	COST_4	Offer price as low or lower than our competitors.

Table2- Continued

Construct	Item Code	Item
Delivery	DEL_1	Order -to- delivery cycle time.
	DEL_2	Order-to-delivery cycle time consistency.
	DEL_3	Correct quantity with right kind of products
	DEL_4	On time deliveries.
Quality	QUAL_1	Conformance to product specification.
	QUAL_2	Reliability of the products.
	QUAL_3	Durability of products.
	QUAL_4	Quality of the products.
	QUAL_5	Satisfaction of customers with the quality of our products.
	QUAL_6	Product capability and performance.
Flexibility	FLEX_1	The speed of new product introduction (development lead time).
	FLEX_2	Offer a large number of product features.
	FLEX_3	Offer a large degree of product variety.
	FLEX_4	Adjust product mix.
	FLEX_5	Develop new product features for our customers.
	FLEX_6	Change product offered to meet customers' needs.
Exploration	EXPLRE_1	Our organizations respond to demands that go beyond our existing products and services.
	EXPLRE_2	We always look for creative ways to satisfy our customer's needs.
	EXPLRE_3	We actively seek new manufacturing technologies and systems.
	EXPLRE_4	We look for novel operational technological ideas by thinking “outside the box.”
	EXPLRE_5	Our success depends on our abilities to explore new operational technologies.
	EXPLRE_6	We aggressively venture into new product segments.
Exploitation	EXPLOIT_1	We frequently make a small adjustment to our existing products and services.
	EXPLOIT_2	We continuously improve the production efficiency of our products and services.
	EXPLOIT_3	We continuously improve the reliability of our product and services.
	EXPLOIT_4	We fine-tune operational activities to keep our current customers satisfied.
	EXPLOIT_5	We increase the levels of automation in our operations.
	EXPLOIT_6	Our firm commits to improve quality and lower cost.

Table 2- Continued

Construct	Item Code	Item
Strategic Integration	SI_1	Our firm's supply chain strategy is well aligned with the corporate strategy.
	SI_2	Our supply chain strategic goals and objectives are clearly defined.
	SI_3	Supply chain strategies and goals are communicated to all employees.
	SI_4	Our firm's strategic goals leverage our company's existing capabilities.
	SI_5	Supply chain strategy is frequently reviewed and revised.
Internal Integration	II_1	We have a high level of responsiveness within our firm to meet other department's need.
	II_2	We have integrated information system across functional areas.
	II_3	In our firm, we have periodic interdepartmental meetings among internal function.
	II_4	Internal functional teams (e.g., operations, purchasing, logistics, sales, marketing, finance, engineering, quality, information technology) work together to accomplish supply chain planning and execution.
	II_5	Planning decisions are based on plans agreed upon by all functional teams
	II_6	Operational and tactical information is regularly exchanged between functional teams.
	II_7	Functional teams are aware of each other's responsibility.

4.3 Content Validity

Content validity is defined as, " a judgment, by experts, of the extent to which a summated scale truly measures the concept that it intended to measure, based on the content of the items" (Flynn et al.,1990, pg. 266). Content validity should be performed first before delving into further validation because poor content validity will render the analysis 'meaningless' (Ahire et al.,1996). Content validity cannot be established by statistics (Flynn et al., 1990), but it can be established through literature review (Chen & Paulraj, 2004; Flynn et al., 1990), and through experts (Flynn et al., 1990). The items used in this study are adapted from earlier studies

after careful review of the literature. To check for content validity of the constructs, the survey instrument was distributed to six practitioners having more than 15 years of experience in the supply chain field. These practitioners checked the survey instrument for clarity, ambiguity, and appropriateness. Only minor changes to the survey instrument were made based on their feedback before launching the survey. The above two steps thus vouch for the content validity of the instrument.

4.4 Data Collection

The survey method was employed to collect the data to test the hypotheses of both research models. Online Survey research firm (Qualtrics) was selected to collect the data for this research. Although, the use of an online survey to reach firms is standard practice in many disciplines such as marketing, but this approach to collect data is new in supply chain management field (Schoenherr et al., 2015). High-quality response and large sample size as per the requirements of the researcher are the two main advantage of using online research firms (Schoenherr et al., 2015).

On the flip side, it is difficult to find the true characteristics of the respondent. Therefore Schoenherr et al., (Schoenherr et al., 2015) suggested different approaches to ensure rigor in data collection process to obtain quality data. This research also employed the guidelines suggested by Schoenherr et al., (2015) during the data collection process. For instance, six screening questions such as the location of the firm, type of industry, association with the current firm, total professional experience, size of the firm, and working area were used to filter out the participants. The participants who were working in U.S. manufacturing sector, having at least one association with the current firm, a total of three years of experience, firms having more than 100 employees, and supply chain/ operations as the working domain were allowed to take the

survey. If a participant did not meet the screening criteria, the online Qualtrics software disqualified the participant from the survey. Also, one attention check question and two trap questions were embedded in the survey to maintain the quality of the data. Attention check questions and trap questions help in identifying the respondents who were not reading the survey questions and were disqualified from taking the survey. Moreover, the respondents IP addresses and time to complete the survey were also recorded. The IP address helps to cross-check the location of the respondent. The participants who completed the survey in less than ten minutes were disqualified from taking the survey. Furthermore, all the responses were checked for any anomaly such as same value response, a mismatch in the number of employees or level of responsibility, which resulted in 302 responses.

As per the requirements of this research, Qualtrics estimated that 4,436 members are eligible to participate in our study from their nationwide panel. Qualtrics research firm estimate that 6o percent of solicitations are filtered out by email spam blocker software or removed by the participants (Long et al., 2011).Accordingly, this research estimate that 1774 viewed our solicitation to complete the survey. Out of 1774, 302 completed the survey, providing a response rate of 17.02 percent.

4.5 Demographic Information

From the manufacturing industry perspective, the data represents approximate fourteen different manufacturing industry as shown in table 3. The varied group of manufacturing industries are represented in the sample such as automotive (13.6%), medical/pharmaceuticals(8.3%), and aerospace/defense (3.3%). Overall, three industries (automotive, industrial products, consumer packaged goods) represent 61.6% of the sample and remaining eleven industries account for 38.4% of the sample.

Table 3 Industry Sector

Industry	Frequency	Percent	Valid Percent	Cumulative Percent
Automotive	41	13.6	13.6	13.6
Medical/Pharmaceuticals	25	8.3	8.3	21.9
Apparel/Textiles	14	4.6	4.6	26.5
Electronics	21	7.0	7.0	33.4
Industrial Products	90	29.8	29.8	63.2
Consumer Packaged Goods	55	18.2	18.2	81.5
Chemicals/plastics	18	6.0	6.0	87.4
Appliances	1	.3	.3	87.7
Aerospace/Defense	10	3.3	3.3	91.1
Packaging	1	.3	.3	91.4
Fabrication	1	.3	.3	91.7
Engineering Services	2	.7	.7	92.4
Furniture	3	1.0	1.0	93.4
Flavors/Signs/Parts kitting/Window covering	20	6.6	6.6	100.0
Total	302	100.0	100.0	

The job title of the respondents was also collected in this study and responses obtained from the participants reflect a range of positions holding as shown in table 4. The distribution of job position indicates that 49% of respondents hold the title of Executive Manager (CEO, VP, Director, GM- 7.3%), Managers (Operations, Production. Supply Chain, Logistics – 21.5%), Managers (Product/ Program/Project/ Sales-20.2%). 32.1% of respondents reported have the title of supply chain specialist(5.6%), supervisor (17.9%), planner(4.3%), buyer (1.3%), scheduler (1.0%), and supply chain coordinator (2.0%). Overall, 81.1% of respondents were in decision making position in the supply chain domain, which suggest that respondents have sufficient knowledge related to the survey.

Table 4 Job Title

Job Title	Frequency	Percent	Valid Percent	Cumulative Percent
CEO/VP/Director/ GM	22	7.3	7.3	7.3
Operations/ Production/Supply Chain/Logistics Manager	65	21.5	21.5	28.8
Managers (Product/Program/Project/Sales)	61	20.2	20.2	49.0
Supply Chain Specialist	17	5.6	5.6	54.6
Supervisor	54	17.9	17.9	72.5
Planner	13	4.3	4.3	76.8
Buyer	4	1.3	1.3	78.1
Scheduler	3	1.0	1.0	79.1
Business Analyst/Consultants	5	1.7	1.7	80.8
Process/ Production/ Quality Engineer	20	6.6	6.6	87.4
Group leader/ Team Lead	14	4.6	4.6	92.1
Supply Chain/ Production Coordinator	6	2.0	2.0	94.0
Others (Purchasing agent/ Manufacturing Associate etc.)	8	2.6	2.6	96.7
Other Specialist (Product/ Training etc.)	6	2.0	2.0	98.7
No-Information	4	1.3	1.3	100.0
Total	302	100.0	100.0	

The distribution of the respondents based on their working area is represented in table 5.All of the respondents were working in supply chain, logistics, procurement and production, and 64.9% of respondents reported the production as their dominant working area. Regarding professional experience, which is shown in table 6, indicates that 95% of respondents have more than five years of total work experience, 43.4% of the respondents have more twenty years of total professional experience. Size of the firm can create bias and size of the firm was measured using the sales revenue, and the total number of employees in the firm. The distribution based on number of employees and sales revenue is tabulated in table 7, and 8 respectively.

Approximately 29.5% of the firms in the sample have employees between 100-500, and 24.5% of the firms have more than 10000 employees. The distribution based on sales revenue is evenly split. Approximately, 50.7% of the firms have sales revenue of less than $500 million, and 49.3% of the firms have sales revenue of more than $500 million. Also, the education of the respondents was captured in this research and distribution of respondents education is shown in table 9. The distribution based on education indicates that 41.1% of respondents have bachelor's degree, 15.6% of respondents have a master degree. 3.3% of respondents have completed their Ph.D., and 25.8% of respondents have spent some years in college. Moreover, the data on age of firm was also obtained from the respondents to understand the sample regarding how long the firm has been in business. The distribution of the firms based on age, as shown in table 10, indicates that majority of the firms (76.8%) in this sample are in business for more than 20 years, which is typical of the manufacturing sector.

Table 5 Working Domain

Work Domain	Frequency	Percent	Valid Percent	Cumulative Percent
Supply Chain	45	14.9	14.9	14.9
Procurement	26	8.6	8.6	23.5
Logistics	35	11.6	11.6	35.1
Production	196	64.9	64.9	100.0
Total	302	100.0	100.0	

Table 6 Professional Experience

Professional Experience	Frequency	Percent	Valid Percent	Cumulative Percent
1-3 years	2	.7	.7	.7
3-5 years	13	4.3	4.3	5.0
5-10 years	38	12.6	12.6	17.5
10- 15 years	57	18.9	18.9	36.4
15 -20 years	61	20.2	20.2	56.6
> 20 years	131	43.4	43.4	100.0
Total	302	100.0	100.0	

Table 7 Number of Employees

Number of Employee	Frequency	Percent	Valid Percent	Cumulative Percent
100-500	89	29.5	29.5	29.5
501-1000	55	18.2	18.2	47.7
1001- 5000	51	16.9	16.9	64.6
5001-10000	32	10.6	10.6	75.2
10000 or more	75	24.8	24.8	100.0
Total	302	100.0	100.0	

Table 8 Sales Revenue

Sales Revenue (USD)	Frequency	Percent	Valid Percent	Cumulative Percent
< 1 Million	3	1.0	1.0	1.0
1-50 Million	82	27.2	27.2	28.1
51- 500 Million	68	22.5	22.5	50.7
501 - 1 Billion	38	12.6	12.6	63.2
1.1- 5 Billion	41	13.6	13.6	76.8
5.1- 10 Billion	24	7.9	7.9	84.8
> 10 Billion	46	15.2	15.2	100.0
Total	302	100.0	100.0	

Table 9 Education Level

Education	Frequency	Percent	Valid Percent	Cumulative Percent
High School	34	11.3	11.3	11.3
Some College	78	25.8	25.8	37.1
College Graduate/ Bachelor's Degree	124	41.1	41.1	78.1
Masters/MBA	47	15.6	15.6	93.7
PHD	10	3.3	3.3	97.0
Others	9	3.0	3.0	100.0
Total	302	100.0	100.0	

Table 10 Age of Firm

Age of Firm	Frequency	Percent	Valid Percent	Cumulative Percent
1-5 years	4	1.3	1.3	1.3
5-10 years	15	5.0	5.0	6.3
10-15 years	17	5.6	5.6	11.9
15- 20 years	34	11.3	11.3	23.2
> 20 years	232	76.8	76.8	100.0
Total	302	100.0	100.0	

4.6 Data Analysis

4.6.1 Technique

SMART- PLS 3.0 was employed to analyze both the proposed research models. SEM analysis can by using different approaches such as Covariance-based SEM (CB-SEM), Partial Least Squares (PLS), Generalized Structural Component Analysis (GSCA), and Nonlinear Universal Structural Relational Modeling (NEUSREL) (Wong, 2013). In social science research, it is a common practice to analysis model by deploying CB- SEM (Wong, 2013), but lately, PLS technique has gained momentum for testing hypothesis. For instance, PLS is widely used in the information system (Ringle et al., 2012), strategic management (Hulland, 1999), and marketing (Hair et al., 2012) and the use of PLS in operations management research is on the rise (Peng & Lai, 2012). In CB- SEM, constructs of the interest are considered as common factors, whereas in PLS weighted composite of manifested variables of a construct is used in place of the construct (Hair et al., 2017). A weighted composite score of manifested variables helps in addressing measurement error, thereby improve the prediction of the target constructs (Hair et al., 2017). PLS-SEM is under debate about its usefulness in analyzing the data (Peng & Lai, 2012). Scholars have laid down guidelines under which PLS should be a more appropriate tool for analysis. For example, researcher claim that PLS should be used when the sample size is small,

and the model is complex (Hair et al., 2014; Hair et al., 2011). Although proponents of PLS argue that it should use for theory building, some advocate that PLS can be used for confirmatory theory testing (Hair et al., 2011). The research model in this study is complicated because of the presence of both mediator and moderation, and both research models are not tested empirically in previous research. Accordingly, the use of PLS-SEM is an appropriate method to test both the research models in this study.

4.6.2 Common Method Bias

All the responses were collected from one respondent both for independent and dependent variables. Although self-reporting is standard practice in management research, the use of self-reporting data has problems associated with it (Podsakoff & Organ, 1986). One of the major cause of concern is known as common method variance (Podsakoff & Organ, 1986) or commonly known as common method bias (Podsakoff et al., 2012). Common method bias cannot be disregarded because the validity of the construct has been established (Podsakoff & Organ, 1986). Measurement of distinct constructs with the same method is the leading cause of method bias because it might be possible that the observed covariation among different construct exists because they are all measured by the same method (Podsakoff et al., 2012). The literature suggests procedural and statistical remedies that can help in controlling and identifying the common method bias (Podsakoff et al., 2012). This study also implemented several procedural remedies to minimize the detrimental effect of method bias. For instance, physical separation of predictor and criterion variables was done as well as anchoring of scales was changed to reduce the method bias as suggested by Podsakoff et al., (2012). These two procedures can reduce the ability of the participant to use earlier responses to fill subsequent responses and thereby facilitate some control for method bias (Podsakoff et al., 2003).

This study also conducted statistical remedies as evidence that common method bias is not a cause of concern. Harmon's one-factor test was conducted on both the research model because this test is commonly used in research to detect method bias. This test assumes that " if a substantial amount of common method variance is present, either (a) a single factor will emerge from the factor analysis, or (b) one " general" factor will account for the majority of the covariance in the independent and criterion variables" (Podsakoff & Organ, 1986, pg. 536). Unrotated principal components factor analysis was done by using SPSS 21.0 for both the research models. For the first model, nine factors emerged from the factor analysis which accounts for 72.25 % of the variance. The result suggests that common method bias not a serious concern for the first research model. The unrotated principal components analysis for the second model resulted in seven factors. These seven factors account for 67.98% of the variance and provide the evidence that common method variance is not a significant issue in this research model. Also, the latent variable approach as suggested by (Podsakoff et al., 2003) was used to detect common method bias. Specifically, the common method technique was used. In a common method factor, a new factor is created, and all the items of constructs are added to this factor (Podsakoff et al., 2003). There are two advantages associated with this method. First, there is no need to identify a factor by the researcher in advance and second, this method accounts for the effect of common method factor on the manifested variables (Podsakoff et al., 2003). Common method factor approach in PLS was done as suggested by Liang et al., (2007) for both models. For the first model, the average substantive variance is 0.703, and the average common method variance is 0.025. The ratio of average substantive to average common method variance is 28.39 to 1. For the second model, the average substantive variance is 0.669, and the average common method variance is 0.009. The ratio of average substantive to average common

method variance is 77.22 to 1. The results suggest that common method is not serious problem in the research models 1 and 2.The results of model 1 are shown in table 11 and of model 2 are shown in table 12.

Table 11 Common Method Bias Results for Research Model1

Construct	Indicator	Substantive Factor Loading(R1)	$R1^2$	Method Factor Loading (R2)	$R2^2$
Agile Supply Chain Strategy	AS_1	0.810	0.656	-0.002	0.000
	AS_2	0.899	0.808	-0.073	0.005
	AS_3	0.910	0.828	-0.177	0.031
	AS_4	0.646	0.417	0.099	0.010
	AS_5	0.740	0.548	0.086	0.007
	AS_6	0.779	0.607	0.002	0.000
	AS_7	0.563	0.317	0.940	0.884
Mass Customization Capability	MCC_1	0.748	0.560	0.067	0.004
	MCC_2	0.866	0.750	-0.046	0.002
	MCC_3	0.757	0.573	-0.086	0.007
	MCC_4	0.851	0.724	0.010	0.000
	MCC_5	0.731	0.534	0.043	0.002
Business Performance	BP_1	0.856	0.733	0.012	0.000
	BP_2	0.853	0.728	-0.045	0.002
	BP_3	0.853	0.728	-0.028	0.001
	BP_4	0.907	0.823	-0.180	0.032
	BP_5	0.889	0.790	-0.101	0.010
	BP_6	0.766	0.587	0.093	0.009
	BP_7	0.761	0.579	0.134	0.018
	BP_8	0.840	0.706	0.045	0.002
	BP_9	0.819	0.671	0.036	0.001
Strategic Integration	SI_1	0.808	0.653	0.043	0.002
	SI_2	0.931	0.867	-0.020	0.000
	SI_3	0.883	0.780	-0.069	0.005
	SI_4	0.791	0.626	0.057	0.003
	SI_5	0.837	0.701	-0.009	0.000
Environmental Uncertainty	ENVIRN_1	0.880	0.774	-0.103	0.011
	ENVIRN_2	0.891	0.794	0.022	0.000
	ENVIRN_3	0.834	0.696	0.075	0.006
Cost	COST_1	0.820	0.672	0.092	0.008
	COST_2	0.902	0.814	-0.014	0.000
	COST_3	0.911	0.830	-0.049	0.002
	COST_4	0.853	0.728	-0.034	0.001

Table11- Continued

Construct	Indicator	Substantive Factor Loading(R1)	$R1^2$	Method Factor Loading (R2)	$R2^2$
Quality	QUAL_1	0.728	0.530	0.140	0.020
	QUAL_2	0.930	0.865	-0.029	0.001
	QUAL_3	0.998	0.996	-0.123	0.015
	QUAL_4	0.955	0.912	-0.070	0.005
	QUAL_5	0.812	0.659	0.052	0.003
	QUAL_6	0.800	0.640	0.044	0.002
Delivery	DEL_1	0.899	0.808	-0.016	0.000
	DEL_2	0.978	0.956	-0.063	0.004
	DEL_3	0.786	0.618	0.088	0.008
	DEL_4	0.897	0.805	-0.004	0.000
Flexibility	FLEX_1	0.520	0.270	0.242	0.059
	FLEX_2	0.835	0.697	0.016	0.000
	FLEX_3	0.935	0.874	-0.131	0.017
	FLEX_4	0.877	0.769	-0.105	0.011
	FLEX_5	0.885	0.783	-0.010	0.000
	FLEX_6	0.804	0.646	0.013	0.000
Average		0.833	0.703	0.018	0.025

Table 12 Common Method Bias Results for Research Model 2

Construct	Indicator	Substantive Factor Loading(R1)	$R1^2$	Method Factor Loading (R2)	$R2^2$
Agile Supply Chain Strategy	AS_1	0.821	0.674	-0.017	0.000
	AS_2	0.921	0.848	-0.102	0.010
	AS_3	0.909	0.826	-0.165	0.027
	AS_4	0.626	0.392	0.123	0.015
	AS_5	0.751	0.564	0.067	0.004
	AS_6	0.760	0.578	0.03	0.001
	AS_7	0.555	0.308	0.098	0.010
Exploration	EXPLRE_1	0.893	0.797	-0.038	0.001
	EXPLRE_2	0.773	0.598	0.025	0.001
	EXPLRE_3	0.825	0.681	-0.073	0.005
	EXPLRE_4	0.88	0.774	0.045	0.002
	EXPLRE_5	0.644	0.415	-0.075	0.006
	EXPLRE_6	0.808	0.653	0.124	0.015

Table12- Continued

Construct	Indicator	Substantive Factor Loading(R1)	$R1^2$	Method Factor Loading (R2)	$R2^2$
Exploitation	EXPLOIT_1	0.745	0.555	0.001	0.000
	EXPLOIT_2	0.782	0.612	-0.189	0.036
	EXPLOIT_3	0.834	0.696	0.038	0.001
	EXPLOIT_4	0.834	0.696	-0.004	0.000
	EXPLOIT_5	0.532	0.283	0.105	0.011
	EXPLOIT_6	0.679	0.461	0.086	0.007
Cost	COST_1	0.842	0.709	0.066	0.004
	COST_2	0.897	0.805	-0.008	0.000
	COST_3	0.878	0.771	-0.003	0.000
	COST_4	0.869	0.755	-0.06	0.004
Quality	QUAL_1	0.757	0.573	0.103	0.011
	QUAL_2	0.937	0.878	-0.038	0.001
	QUAL_3	0.898	0.806	-0.143	0.020
	QUAL_4	0.941	0.885	-0.053	0.003
	QUAL_5	0.788	0.621	0.081	0.007
	QUAL_6	0.784	0.615	0.063	0.004
Delivery	DEL_1	0.959	0.920	-0.092	0.008
	DEL_2	0.966	0.933	-0.05	0.003
	DEL_3	0.759	0.576	0.125	0.016
	DEL_4	0.878	0.771	0.02	0.000
Flexibility	FLEX_1	0.562	0.316	0.195	0.038
	FLEX_2	0.828	0.686	0.026	0.001
	FLEX_3	0.926	0.857	-0.125	0.016
	FLEX_4	0.874	0.764	-0.106	0.011
	FLEX_5	0.896	0.803	-0.023	0.001
	FLEX_6	0.773	0.598	0.054	0.003
Internal Integration	II_1	0.572	0.327	0.265	0.070
	II_2	0.751	0.564	0.032	0.001
	II_3	0.755	0.570	0	0.000
	II_4	0.835	0.697	-0.014	0.000
	II_5	0.919	0.845	-0.079	0.006
	II_6	0.989	0.978	-0.119	0.014
	II_7	0.859	0.738	-0.052	0.003
Average		0.810	0.669	0.003	0.009

4.6.3 Psychometric properties of constructs

The empirical research in operations management, in line with empirical research in other fields, is to investigate the relationship among variables of interest to the researcher and correct identification of relationship is a function of how closely the items measure the variables (O'Leary-Kelly & Vokurka, 1998). Construct validity and reliability are two methods to assess the quality of measures (items) (Forza, 2002). The assessment of construct validity is an essential step in research process because construct validity refers to, "the assessment of the degree to which a measure correctly measures its targeted variable" and the first step for construct validity is content validity (O'Leary-Kelly & Vokurka, 1998, pg. 389). The content validity of both research model is already detailed in section 4.3.

4.6.3.1 Convergent and Discriminant Validity

Convergent validity and discriminant validity are two ways to ascertain the construct validity (Campbell & Fiske, 1959). Convergent validity refers to the degree of agreements on the same concept by multiple methods, whereas discriminant validity refers to the degree to which two or more concepts are in fact different or unique (Bagozzi et al.,1991). In other words, if individual items converge or load on their respective constructs reflects good convergent validity, whereas discriminant validity is reflected how items of one latent variable are discriminant from items of other latent variables (Braunscheidel & Suresh, 2009). Convergent validity refers to the degree to which items of a construct are correlated, and if items of construct explain the more variance of the construct (Hair et al., 2017). Discriminant validity refers to the degree to which all the constructs are unique, and each of construct in the research model represents the concept that is not reflected by other constructs (Hair et al., 2017).

4.6.3.1.1 Convergent Validity

The literature suggests two methods to evaluate the convergent validity. First, the loading of items of the reflective construct and second, the average variance extracted (AVE) should be analyzed to provide evidence of convergent validity (Hair et al., 2017). Both methods were employed for two research models to test for convergent validity. The loading of items as well as the statistical significance of each item should be tested to provide evidence of convergent validity (Hair et al., 2017). Regarding the loading of the items; it has been recommended that standardized factor loading should at least 0.708, and the idea behind this value is that shared variance between the latent variable and its manifested variables should be more than the variance due to measurement error (Hair et al., 2017). For the first model, there were 50 items, and of 50 items, the loading of one item of environmental uncertainty (The demand for our firm's products is unstable and unpredictable) was 0.307. Also, the loading one item of agile supply chain strategy (Provide customers with personalized products) and mass customization capability (Our set up costs, when changing from one product to another, are very low) was 0.640 and 0.687 respectively.

Items with the loading of less than 0.40 are considered weak and should be removed from further analysis (Hair et al., 2011). Based on these recommendations, the demand for our firm's products is unstable and unpredictable item was removed from the research model. The remaining 49 items have factor loading in the range of 0.640 and 0.926. It is worthwhile to note that out of 49 items only two items have loading between 0.60 and 0.70 and rest of 38 items have loadings more than 0.708. In the second research model, there are 46 items, and factor loadings of all the items were above the recommended threshold level of 0.708 but one item. One item of agile supply chain strategy construct (Provide customers with personalized products) have a

loading of 0.639. Overall, the second model provides evidence of convergent validity with item loading ranging from 0.639 to 0.922. In addition to the values of items loading, the significance of each item loading was checked to asses the convergent validity, and all item loadings were significant in both the models. Factor loading along with their T statistics and a significance level of model 1 and model 2 are represented in table 13 and 14 respectively.

Table 13 Factor Loadings of Model 1

Construct	Item Code	Item Description	Item Loading	T-Statistics	P value
Agile Supply Chain Strategy	AS_1	Respond effectively to changing requirements of the design.	0.795	26.124	***
	AS_2	Respond quickly to customization requirements.	0.844	41.633	***
	AS_3	Handle changes in product design.	0.766	18.001	***
	AS_4	Maintain a higher capacity buffer to respond to a volatile market.	0.724	21.532	***
	AS_5	Select suppliers based on their performance on flexibility.	0.811	35.530	***
	AS_6	Select suppliers based on their performance on responsiveness.	0.786	33.037	***
	AS_7	Provide customers with personalized products.	0.640	15.448	***
Business Performance	BP_1	Return on Investment (ROI).	0.865	51.594	***
	BP_2	Return on Assets (ROA).	0.814	33.051	***
	BP_3	Return on Sales (ROS).	0.827	38.281	***
	BP_4	Market share.	0.750	28.377	***
	BP_5	Growth in market share.	0.801	33.678	***
	BP_6	Growth in sales.	0.847	54.147	***
	BP_7	Growth in return on investment (ROI).	0.878	59.366	***
	BP_8	Growth in return on asset (ROA).	0.882	72.600	***
	BP_9	Growth in profit.	0.849	50.586	***

Table 13- Continued

Construct	Item Code	Item Description	Item Loading	T-Statistics	P value
Cost	COST_1	Produce products with low costs	0.897	63.317	***
	COST_2	Produce products with low inventory costs.	0.887	59.110	***
	COST_3	Produce products with low overhead costs	0.868	48.796	***
	COST_4	Offer price as low or lower than our competitors.	0.831	32.707	***
Delivery	DEL_1	Order -to- delivery cycle time.	0.885	42.399	***
	DEL_2	Order-to-delivery cycle time consistency.	0.926	105.843	***
	DEL_3	Correct quantity with right kind of products	0.861	48.253	***
	DEL_4	On time deliveries.	0.893	66.530	***
Environmental Uncertainty	ENVIRN_1	The rate at which products and services become outdated in our industry is extremely high.	0.792	22.608	***
	ENVIRN_2	The rate of innovation of new products and services in our industry is extremely high.	0.908	62.993	***
	ENVIRN_3	The demand for our firm's products is unstable and unpredictable	N/A		
	ENVIRN_4	The rate of innovation of new operating processes is extremely high.	0.894	53.474	***
Flexibility	FLEX_1	Speed of new product introduction (development lead time).	0.733	22.025	***
	FLEX_2	Offer a large number of product features.	0.845	38.960	***
	FLEX_3	Offer a large degree of product variety.	0.825	34.538	***
	FLEX_4	Adjust product mix.	0.785	21.376	***
	FLEX_5	Develop new product features to our customers.	0.875	60.797	***
	FLEX_6	Change product offered to meet customers' needs.	0.814	35.590	***

Table 13- Continued

Construct	Item Code	Item Description	Item Loading	T-Statistics	P value
Mass Customization Capability	MCC_1	We are highly capable of large-scale product customization.	0.800	34.749	***
	MCC_2	We can easily add significant product variety without increasing costs.	0.829	40.421	***
	MCC_3	Our set up costs, when changing from one product to another, are very low.	0.687	16.388	***
	MCC_4	We can customize products while maintaining high volume.	0.860	40.718	***
	MCC_5	We can add product variety without sacrificing quality.	0.767	28.985	***
Quality	QUAL_1	Conformance to product specification.	0.847	44.236	***
	QUAL_2	Reliability of the products.	0.905	69.560	***
	QUAL_3	Durability of products.	0.893	54.934	***
	QUAL_4	Quality of the products.	0.895	53.149	***
	QUAL_5	Satisfaction of customers with the quality of our products.	0.857	53.606	***
	QUAL_6	Product capability and performance.	0.836	30.862	***
Strategic Integration	SI_1	Our firm's supply chain strategy is well aligned with the corporate strategy.	0.844	44.879	***
	SI_2	Our supply chain strategic goals and objectives are clearly defined.	0.914	80.629	***
	SI_3	Supply chain strategies and goals are communicated to all employees.	0.822	33.198	***
	SI_4	Our firm's strategic goals leverage our company's existing capabilities.	0.828	32.664	***
	SI_5	Supply chain strategy is frequently reviewed and revised.	0.841	38.045	***

*** P value< 0.001

Table 14- Factor Loadings of Model 2

Construct	Item Code	Item Description	Item Loading	T-Statistics	P value
Agile Supply Chain Strategy	AS_1	Respond effectively to changing requirements of design.	0.797	26.352	***
	AS_2	Respond quickly to customization requirements.	0.839	35.471	***
	AS_3	Handle changes in product design.	0.775	18.647	***
	AS_4	Maintain a higher capacity buffer to respond to a volatile market.	0.726	22.271	***
	AS_5	Select suppliers based on their performance on flexibility.	0.805	33.747	***
	AS_6	Select suppliers based on their performance on responsiveness.	0.788	32.250	***
	AS_7	Provide customers with personalized products.	0.639	15.051	***
Exploration	EXPLRE_1	Our organizations respond to demands that go beyond our existing products and services.	0.777	26.131	***
	EXPLRE_2	We always look for creative ways to satisfy our customer's needs.	0.792	27.734	***
	EXPLRE_3	We actively seek new manufacturing technologies and systems.	0.836	43.614	***
	EXPLRE_4	We look for novel operational technological ideas by thinking “outside the box.”	0.861	50.770	***
	EXPLRE_5	Our success depends on our abilities to explore new operational technologies.	0.821	39.393	***
	EXPLRE_6	We aggressively venture into new product segments.	0.745	26.338	***

Table 14- Continued

Construct	Item Code	Item Description	Item Loading	T-Statistics	P value
Exploitation	EXPLOIT_1	We frequently make a small adjustment to our existing products and services.	0.737	20.814	***
	EXPLOIT_2	We continuously improve the production efficiency of our products and services.	0.853	46.109	***
	EXPLOIT_3	We continuously improve the reliability of our product and services.	0.868	46.412	***
	EXPLOIT_4	We fine-tune operational activities to keep our current customers satisfied.	0.831	36.577	***
	EXPLOIT_5	We increase the levels of automation in our operations.	0.630	14.973	***
	EXPLOIT_6	Our firm commits to improve quality and lower cost.	0.758	24.122	***
Cost	COST_1	Produce products with low costs	0.895	62.643	***
	COST_2	Produce products with low inventory costs.	0.892	63.853	***
	COST_3	Produce products with low overhead costs	0.879	55.158	***
	COST_4	Offer price as low or lower than our competitors.	0.815	26.339	***
Delivery	DEL_1	Order -to- delivery cycle time.	0.874	32.493	***
	DEL_2	Order-to-delivery cycle time consistency.	0.922	91.866	***
	DEL_3	Correct quantity with right kind of products	0.870	57.369	***
	DEL_4	On time deliveries.	0.897	74.401	***

Table 14- Continued

Construct	Item Code	Item Description	Item Loading	T-Statistics	P value
Internal Integration	II_1	We have a high level of responsiveness within our firm to meet other department's need.	0.791	29.184	***
	II_2	We have integrated information system across functional areas.	0.777	21.914	***
	II_3	In our firm, we have periodic interdepartmental meetings among internal function.	0.757	23.996	***
	II_4	Internal functional teams (e.g., operations, purchasing, logistics, sales, marketing, finance, engineering, quality, information technology) work together to accomplish supply chain planning and execution.	0.824	36.213	***
	II_5	Planning decisions are based on plans agreed upon by all functional teams	0.852	46.414	***
	II_6	Operational and tactical information is regularly exchanged between functional teams.	0.891	62.101	***
	II_7	Functional teams are aware of each other's responsibility.	0.812	33.322	***
Flexibility	FLEX_1	Speed of new product introduction (development lead time).	0.724	19.885	***
	FLEX_2	Offer a large number of product features.	0.850	42.575	***
	FLEX_3	Offer a large degree of product variety.	0.820	31.065	***
	FLEX_4	Adjust product mix.	0.782	20.158	***
	FLEX_5	Develop new product features to our customers.	0.879	65.222	***
	FLEX_6	Change product offered to meet customers' needs.	0.820	39.997	***

Table 14- Continued

Construct	Item Code	Item Description	Item Loading	T-Statistics	P value
Quality	QUAL_1	Conformance to product specification.	0.842	42.043	***
	QUAL_2	Reliability of the products.	0.905	70.865	***
	QUAL_3	Durability of products.	0.893	56.855	***
	QUAL_4	Quality of the products.	0.896	52.543	***
	QUAL_5	Satisfaction of customers with the quality of our products.	0.858	54.099	***
	QUAL_6	Product capability and performance.	0.839	35.029	***

***P value< .001

Average variance extracted (AVE) is the second approach to establish convergent validity, and AVE of all the reflective latent variables having multiple manifested variable should be calculated (Hair et al., 2017). Convergent validity can be established if the average variance extracted (AVE) is 0.50 or higher (Hair et al., 2014; Hair et al., 2011). AVE value of more than 0.50 indicates that more than half of the variance in items is explained by the latent variable (Hair et al., 2014). AVE for all of the constructs of model 1 was higher than 0.50 with values in the range of 0.589 to 0.795. Similarly, the AVE for all the first order constructs of the second model exceeded the threshold value of 0.50 with values ranging from 0.592 to 0.794. AVE of all the constructs of model 1 and model 2 are tabulated in table 15 and 16 respectively.

Table 15- AVE of Model 1

Construct	Average Variance Extracted(AVE)
Agile Supply Chain Strategy	0.589
Business Performance	0.699
Cost	0.758
Delivery	0.795
Environmental Uncertainty	0.752
Flexibility	0.663
Mass Customization Capability	0.625
Quality	0.762
Strategic Integration	0.723

Table 16- AVE of Model 2

Construct	Average Variance Extracted (AVE)
Agile Supply Chain Strategy	0.592
Cost	0.758
Delivery	0.794
Exploit	0.614
Explore	0.650
Flexibility	0.663
Internal Integration	0.666
Quality	0.762

4.6.3.1.2 Discriminant Validity

The discriminant validity of both the research model was tested using the Fornell & Larcker (1981) approach. According to this criterion," the construct shares more variance with its indicators than with any other construct" (Hair et al., 2014, pg. 112). To establish discriminant validity using Fornell & Larcker criterion, AVE of each of latent variable should be more than the highest squared correlation with any other latent variable (Hair et al., 2014). To put it differently, the square root of AVE of the latent variable should be more than the correlation among the latent variables (Braunscheidel & Suresh, 2009). Table 17 and 18 represent the correlations among constructs, and the square root of AVE is on the diagonal of both the tables for research model 1 and 2 respectively. The results provide evidence of discriminant validity as the correlations among constructs are less than the square root of AVE.

Table 17 – Discriminant Validity of Model 1

Construct	ASC	BP	Cost	Delivery	EU	Flexibility	MCC	Quality	SI
ASC	**0.768**								
BP	0.491	**0.836**							
Cost	0.465	0.620	**0.871**						
Delivery	0.447	0.655	0.658	**0.891**					
EU	0.326	0.352	0.372	0.364	**0.867**				
Flexibility	0.480	0.605	0.568	0.639	0.363	**0.814**			
MCC	0.486	0.505	0.574	0.580	0.348	0.649	**0.791**		
Quality	0.446	0.597	0.513	0.678	0.344	0.597	0.533	**0.873**	
SI	0.448	0.529	0.489	0.610	0.385	0.536	0.526	0.637	**0.850**

ASC- Agile Supply Chain Strategy, BP- Business Performance, EU- Environmental Uncertainty MCC- Mass Customization Capability, SI- Strategic Integration

Table 18 – Discriminant Validity of Model 2

Construct	ASC	Cost	Delivery	Exploit	Explore	Flexibility	II	Quality
ASC	**0.769**							
Cost	0.466	**0.871**						
Delivery	0.446	0.653	**0.891**					
Exploit	0.617	0.546	0.637	**0.784**				
Explore	0.529	0.472	0.508	0.744	**0.806**			
Flexibility	0.473	0.564	0.641	0.588	0.582	**0.814**		
II	0.466	0.444	0.555	0.641	0.517	0.457	**0.816**	
Quality	0.446	0.512	0.679	0.666	0.567	0.598	0.558	**0.873**

ASC- Agile Supply Chain Strategy, II- Internal Integration.

Cross loading of items on another construct is the other approach to provide evidence of discriminant validity (Hair et al., 2017). The idea behind this approach is that manifested variables should have a higher correlation with their associated construct than the correlation with other constructs (Hair et al., 2017). They also suggested that items in the rows and constructs in the columns is the excellent way to report the cross loading. Cross loadings of items of model 1 and model 2 are shown in table 19 and 20 respectively. The results of cross loading also suggest that discriminant validity is not a concern for both the models.

Table 19- Cross Loading of Model 1

Item Code	ASC	BP	Cost	Delivery	EU	Flexibility	MCC	Quality	SI
AS_1	**0.783**	0.399	0.315	0.329	0.212	0.374	0.318	0.421	0.404
AS_2	**0.854**	0.358	0.364	0.323	0.258	0.357	0.414	0.348	0.343
AS_3	**0.759**	0.290	0.229	0.240	0.147	0.280	0.257	0.304	0.346
AS_4	**0.725**	0.383	0.389	0.356	0.315	0.392	0.390	0.331	0.369
AS_5	**0.797**	0.477	0.476	0.443	0.259	0.391	0.394	0.318	0.351
AS_6	**0.768**	0.397	0.406	0.378	0.195	0.320	0.324	0.345	0.346
AS_7	**0.675**	0.312	0.277	0.297	0.301	0.414	0.438	0.324	0.262
BP_1	0.413	**0.866**	0.532	0.585	0.269	0.525	0.423	0.535	0.474
BP_2	0.410	**0.813**	0.515	0.530	0.261	0.478	0.383	0.454	0.403
BP_3	0.393	**0.827**	0.559	0.548	0.243	0.503	0.383	0.476	0.416
BP_4	0.330	**0.749**	0.429	0.433	0.213	0.441	0.306	0.379	0.341
BP_5	0.394	**0.799**	0.496	0.493	0.298	0.483	0.370	0.406	0.366
BP_6	0.443	**0.847**	0.528	0.559	0.330	0.531	0.481	0.541	0.466
BP_7	0.473	**0.878**	0.550	0.609	0.358	0.548	0.470	0.590	0.489
BP_8	0.451	**0.883**	0.540	0.569	0.332	0.539	0.493	0.524	0.482
BP_9	0.375	**0.852**	0.509	0.578	0.316	0.495	0.451	0.540	0.504
COST_1	0.428	0.588	**0.899**	0.611	0.358	0.558	0.572	0.457	0.473
COST_2	0.424	0.555	**0.884**	0.565	0.275	0.496	0.485	0.460	0.445
COST_3	0.409	0.523	**0.864**	0.543	0.306	0.455	0.445	0.443	0.443
COST_4	0.358	0.488	**0.835**	0.566	0.347	0.457	0.484	0.427	0.341
DEL_1	0.416	0.611	0.654	**0.884**	0.297	0.562	0.503	0.530	0.490
DEL_2	0.403	0.584	0.613	**0.926**	0.366	0.550	0.528	0.600	0.556
DEL_3	0.398	0.578	0.519	**0.862**	0.294	0.575	0.511	0.668	0.559
DEL_4	0.375	0.564	0.560	**0.893**	0.340	0.594	0.526	0.618	0.570
ENVIRN_1	0.220	0.234	0.271	0.217	**0.810**	0.238	0.272	0.187	0.222
ENVIRN_2	0.290	0.323	0.336	0.336	**0.904**	0.331	0.302	0.344	0.377
ENVIRN_3	0.327	0.345	0.352	0.376	**0.885**	0.361	0.328	0.344	0.381
FLEX_1	0.398	0.487	0.557	0.586	0.389	**0.729**	0.544	0.429	0.448
FLEX_2	0.396	0.537	0.481	0.532	0.317	**0.846**	0.539	0.515	0.449
FLEX_3	0.385	0.467	0.421	0.437	0.231	**0.828**	0.549	0.480	0.354
FLEX_4	0.351	0.437	0.467	0.467	0.260	**0.785**	0.466	0.414	0.401
FLEX_5	0.392	0.545	0.443	0.557	0.331	**0.874**	0.542	0.522	0.499
FLEX_6	0.415	0.474	0.401	0.535	0.236	**0.814**	0.519	0.547	0.464

Table 19- Continued

Item Code	ASC	BP	Cost	Delivery	EU	Flexibility	MCC	Quality	SI
MCC_1	0.478	0.420	0.420	0.474	0.343	0.540	**0.801**	0.455	0.436
MCC_2	0.376	0.427	0.515	0.442	0.308	0.531	**0.829**	0.404	0.361
MCC_3	0.210	0.358	0.385	0.390	0.176	0.372	**0.687**	0.372	0.335
MCC_4	0.454	0.423	0.493	0.500	0.336	0.605	**0.860**	0.413	0.457
MCC_5	0.370	0.366	0.450	0.480	0.194	0.491	**0.767**	0.464	0.479
QUAL_1	0.410	0.549	0.465	0.647	0.278	0.533	0.504	**0.848**	0.570
QUAL_2	0.382	0.552	0.458	0.580	0.298	0.519	0.489	**0.907**	0.566
QUAL_3	0.358	0.504	0.443	0.529	0.304	0.509	0.452	**0.895**	0.509
QUAL_4	0.379	0.515	0.443	0.565	0.303	0.513	0.451	**0.895**	0.559
QUAL_5	0.398	0.493	0.438	0.638	0.330	0.522	0.470	**0.855**	0.582
QUAL_6	0.408	0.506	0.436	0.582	0.288	0.530	0.419	**0.833**	0.545
SI_1	0.435	0.457	0.466	0.533	0.274	0.482	0.463	0.493	**0.844**
SI_2	0.430	0.459	0.438	0.566	0.284	0.488	0.465	0.587	**0.914**
SI_3	0.352	0.393	0.336	0.504	0.426	0.412	0.390	0.524	**0.822**
SI_4	0.339	0.504	0.416	0.520	0.339	0.445	0.406	0.595	**0.828**
SI_5	0.344	0.435	0.413	0.474	0.330	0.446	0.495	0.516	**0.841**

Table 20- Cross Loading of Model 2

Construct	ASC	Cost	Delivery	Exploit	Explore	Flexibility	II	Quality
AS_1	**0.795**	0.318	0.330	0.465	0.401	0.375	0.363	0.422
AS_2	**0.839**	0.366	0.323	0.460	0.364	0.355	0.355	0.348
AS_3	**0.774**	0.234	0.240	0.385	0.362	0.278	0.346	0.304
AS_4	**0.728**	0.390	0.357	0.525	0.427	0.392	0.388	0.330
AS_5	**0.807**	0.476	0.442	0.503	0.459	0.391	0.380	0.318
AS_6	**0.787**	0.404	0.377	0.496	0.421	0.320	0.394	0.345
AS_7	**0.637**	0.275	0.296	0.453	0.386	0.414	0.261	0.325
COST_1	0.429	**0.893**	0.609	0.539	0.456	0.557	0.400	0.457
COST_2	0.422	**0.891**	0.562	0.469	0.385	0.493	0.432	0.459
COST_3	0.411	**0.880**	0.542	0.473	0.424	0.453	0.429	0.443
COST_4	0.356	**0.817**	0.563	0.412	0.371	0.455	0.270	0.426
DEL_1	0.414	0.650	**0.878**	0.508	0.426	0.562	0.404	0.529
DEL_2	0.405	0.612	**0.922**	0.550	0.465	0.550	0.525	0.599
DEL_3	0.400	0.519	**0.868**	0.607	0.474	0.576	0.522	0.667
DEL_4	0.374	0.556	**0.896**	0.598	0.444	0.594	0.517	0.617

Table 20- Continued

Construct	ASC	Cost	Delivery	Exploit	Explore	Flexibility	II	Quality
EXPLOIT_1	0.553	0.482	0.467	**0.744**	0.540	0.461	0.450	0.406
EXPLOIT_2	0.502	0.426	0.485	**0.849**	0.612	0.411	0.531	0.540
EXPLOIT_3	0.539	0.445	0.551	**0.868**	0.636	0.538	0.572	0.604
EXPLOIT_4	0.479	0.405	0.546	**0.829**	0.607	0.542	0.522	0.559
EXPLOIT_5	0.359	0.411	0.454	**0.633**	0.517	0.381	0.407	0.414
EXPLOIT_6	0.455	0.406	0.483	**0.755**	0.579	0.416	0.515	0.586
EXPLRE_1	0.425	0.319	0.356	0.539	**0.775**	0.464	0.376	0.463
EXPLRE_2	0.451	0.345	0.407	0.579	**0.791**	0.506	0.367	0.498
EXPLRE_3	0.427	0.398	0.392	0.614	**0.836**	0.418	0.432	0.432
EXPLRE_4	0.425	0.446	0.479	0.654	**0.862**	0.441	0.539	0.495
EXPLRE_5	0.409	0.301	0.365	0.609	**0.821**	0.439	0.439	0.449
EXPLRE_6	0.423	0.466	0.455	0.598	**0.746**	0.560	0.335	0.407
FLEX_1	0.388	0.555	0.586	0.487	0.413	**0.724**	0.431	0.429
FLEX_2	0.393	0.476	0.533	0.509	0.550	**0.851**	0.381	0.516
FLEX_3	0.379	0.420	0.438	0.439	0.444	**0.822**	0.304	0.480
FLEX_4	0.352	0.466	0.466	0.395	0.425	**0.782**	0.323	0.413
FLEX_5	0.387	0.443	0.559	0.507	0.524	**0.878**	0.398	0.522
FLEX_6	0.406	0.400	0.536	0.520	0.470	**0.818**	0.387	0.547
II_1	0.436	0.442	0.519	0.589	0.535	0.507	**0.794**	0.478
II_2	0.329	0.336	0.409	0.538	0.420	0.332	**0.775**	0.488
II_3	0.360	0.313	0.425	0.469	0.373	0.364	**0.752**	0.406
II_4	0.363	0.349	0.481	0.516	0.420	0.346	**0.821**	0.456
II_5	0.416	0.367	0.445	0.521	0.392	0.334	**0.856**	0.416
II_6	0.365	0.361	0.457	0.521	0.377	0.340	**0.892**	0.482
II_7	0.368	0.339	0.408	0.482	0.405	0.350	**0.812**	0.449
QUAL_1	0.412	0.465	0.650	0.588	0.470	0.534	0.490	**0.843**
QUAL_2	0.380	0.457	0.582	0.611	0.516	0.521	0.495	**0.906**
QUAL_3	0.357	0.444	0.532	0.538	0.486	0.509	0.446	**0.894**
QUAL_4	0.381	0.444	0.567	0.589	0.523	0.514	0.480	**0.897**
QUAL_5	0.396	0.437	0.640	0.580	0.485	0.523	0.536	**0.855**
QUAL_6	0.407	0.436	0.584	0.578	0.487	0.532	0.471	**0.838**

4.6.3.2 Reliability

"Reliability measures the extent to which a questionnaire, summated scale or item which is repeatedly administered to the same people will yield the same results" (Flynn et al., 1990, pg.

265). Reliability is established by using the coefficient of equivalence, and Cronbach's alpha represents the coefficient of equivalence, which also most common choice to establish reliability (Gerbing & Anderson, 1988). The threshold value or minimum acceptable value of Cronbach's alpha is .70 (Flynn et al., 1990), and reliability result of all the constructs for both models are well above this acceptable value of .70. Cronbach's alpha underestimates the internal consistency because it is sensitive to numbers of manifested variables (Hair et al., 2017), and they suggested to measure composite reliability as another indicator to establish reliability. The threshold value for composite reliability is 0.70 (Sosik et al.,2009). The result of Cronbach's alpha and composite reliability is well above 0.70 for both models, which suggest good reliability. The table 21 and 22 represent the reliability measure for model 1 and 2 respectively.

Table 21 – Reliability Data of Model 1

Construct	Cronbach's Alpha	Composite Reliability
Agile Supply Chain Strategy	0.884	0.910
Business Performance	0.946	0.954
Cost	0.894	0.926
Delivery	0.914	0.939
Environmental Uncertainty	0.836	0.900
Flexibility	0.897	0.922
Mass Customization Capability	0.849	0.892
Quality	0.937	0.950
Strategic Integration	0.904	0.929

Table 22- Reliability Data of Model 2

Construct	Cronbach's Alpha	Composite Reliability
Agile Supply Chain Strategy	0.884	0.910
Cost	0.894	0.926
Delivery	0.914	0.939
Exploit	0.871	0.904
Explore	0.892	0.917
Flexibility	0.897	0.922
Internal Integration	0.916	0.933
Quality	0.937	0.95

4.6.4 Structural Model 1

The structural model represents the path model based on the concepts after establishing the reliability and validity of the constructs (Hair et al., 2017). Structural model in PLS-SEM provides the standardized path coefficients and bootstrapping of the model will provide t and p values to ascertain the significance of the path coefficients. The literature on PLS-SEM suggests that there is no goodness of fit indices for the structural model in PLS-SEM and R^2 of endogenous constructs can be used to asses the predictive power of the model (Hair et al., 2017). R^2 value of 0.67, 0.33, and 0.19 are considered substantial, moderate, and weak respectively for endogenous constructs of the research model (Chin, 1998). R^2 values of all the endogenous constructs but three met the threshold of moderate level. R^2 values of model 1 and 2 are tabulated in table 23 and 24 respectively.

Table 23- R^2 values of Model 1

Constructs	R Square
Cost	0.335
Delivery	0.348
Flexibility	0.422
Quality	0.291
Mass Customization Capability	0.367
Business Performance	0.291

Table 24- R^2 values of Model 2

Constructs	R Square
Cost	0.310
Delivery	0.377
Flexibility	0.413
Operational Ambidexterity	0.381
Quality	0.432

4.6.4.1 Main Effect of Model 1

In the structural model, two control variables were added to control for any effect of size and age of firm on mass customization capability, four operational performance, and business performance dimensions. The structural model was run using SMARP PLS3.0 to asses the direct effect by finding the path coefficient for hypothesis H1, H2, H3, H4, H5, H6, and H7. Bootstrapping with 5000 bootstrap sample was done to evaluate the significance of path coefficients (Henseler et al.,2016). The standardized path coefficient along with t statistics and p values are shown in table 25. For control variables, the results suggest the size of the firm has a positive relationship with business and delivery performance. Also, the size of the firm was negatively related to mass customization capability. Moreover, the age of the firm was negatively related to cost performance. The result indicates that agile supply chain strategy has a positive and significant relationship with mass customization capability ($\beta = 0.307$, t value = 5.895). Therefore H1 is supported. These results suggest that mass customization capability is positively related to cost ($\beta = 0.573$, t value = 13.998), quality ($\beta = 0.540$, t value = 11.297), delivery ($\beta = 0.586$, t value = 14.757), flexibility ($\beta = 0.651$, t value = 20.601), business performance ($\beta = 0.508$, t value = 10.925). Therefore, H2, H3, H4, H5, and H6 are supported. Also, the strategic integration has positive association with mass customization capability ($\beta = 0.397$, t value = 6.731). Hence the results show support for H7.

Table 25- Main Effect of Model 1

Relationship	Path Coefficient	T Statistics	P Values
Size -> BP	0.193	3.785	***
Size -> Cost	0.035	0.710	NS
Size -> Delivery	0.109	2.241	**
Size -> Flexibility	0.017	0.368	NS
Size -> MCC	-0.106	2.282	**
Size -> Quality	0.060	1.202	NS
Age -> BP	-0.027	0.506	NS
Age -> Cost	-0.072	1.799	*
Age -> Delivery	-0.038	0.913	NS
Age -> Flexibility	0.019	0.390	NS
Age -> MCC	-0.020	0.532	NS
Age -> Quality	0.041	0.859	NS
ASC -> MCC	0.307	5.895	***
MCC -> BP	0.518	10.925	***
MCC -> Cost	0.573	13.998	***
MCC -> Delivery	0.586	14.757	***
MCC -> Flexibility	0.651	20.601	***
MCC -> Quality	0.540	11.297	***
SI -> MCC	0.397	6.731	***

* P- value <0.10, ** P- value<0.05, *** P-value <0.001 , NS- Not Significant

4.6.4.2 Mediation Effect of Mass Customization Capability

The role of the mediator is to explain," how or why such effects occur" (Baron & Kenny, 1986, pg. 1176). Mediation occurs when an independent variable has an impact on the dependent variable indirectly through another variable (Preacher & Hayes, 2008). The literature describes various ways to establish the mediation effect. In this study, a two-step process was followed as suggested in the literature (Tarafdar & Qrunfleh, 2017). First, the impact of agile supply chain strategy was examined on all the five dependent variables with 5000 bootstraps. Size and age were also included as a control variable in the model. The results indicate that the impact of agile supply chain strategy on cost ($\beta = 0.464$, t value = 11.583), quality ($\beta = 0.450$, t value = 8.854), delivery ($\beta = 0.447$, t value = 9.531), flexibility ($\beta = 0.475$, t value = 9.918), and business performance ($\beta = 0.94$, t value = 11.583) are positive and significant. Second, mass

customization capability was inserted as a mediator, and the model was tested for the direct and indirect effect of ASC on all five performance variables. The model was rerun with 5000 bootstrapping with 95% confidence level. Also, bias-corrected and accelerated bootstrap confidence interval (95%) approach was used to detect whether zero value is present in the confidence interval (Hair et al., 2017). In the second step, the coefficient of agile supply chain strategy (direct effect) on cost (β = 0.248, t value = 4.939), quality (β = 0.249, t value = 4.092), delivery (β = 0.216, t value = 4.000), flexibility (β = 0.214, t value = 4.248), and business performance (β = 0.319, t value = 6.192) were lower in value but all paths were significant. The indirect effect of agile supply chain strategy on cost (β = 0.216, t value = 6.472), quality (β = 0.201, t value = 6.082), delivery (β = 0.230, t value = 6.809), flexibility (β = 0.262, t value = 9.042), and business performance (β = 0.174, t value = 5.268) was significant. Also, 95% bias-corrected and accelerated (BCa) confidence interval for all five indirect effects did not contain the zero value, thus support the mediation effect. The result of the direct and indirect effect of agility on all five performance dimensions indicate the partial mediation of mass customization capability. Hence, there is partial support for hypotheses H8a, H8b, H8c, H8d, and H8e. The results of direct and indirect effects are summarized in table 26.

Table 26- Mediation effect of Mass Customization Capability

Hypothesis	Direct Beta without MCC as a mediator	Direct beta with MCC as a mediator	Indirect effect (beta)	95% CI of the indirect effect	Type of Mediation
ASC---MCC---Cost	0.464 (10.607)***	0.248 (4.939)***	0.216 (6.472)***	0.153-0.283	Partial Mediation
ASC---MCC---Quality	0.450 (8.854)***	0.249 (4.092)***	0.201 (6.082)***	0.140-0.269	Partial Mediation
ASC---MCC---Delivery	0.447 (9.531)***	0.217 (4.000)***	0.230 (6.809)***	0.166-0.299	Partial Mediation
ASC---MCC---Flexibility	0.475 (9.918)***	0.214 (4.248)***	0.262 (9.042)***	0.207-0.322	Partial Mediation
ASC---MCC---BP	0.494 (11.583)***	0.319 (6.192)***	0.174 (5.268)***	0.113-0.240	Partial Mediation

The values in the parenthesis are T values. *** P value<0.001

4.6.4.3 Moderating Effect of Environmental Uncertainty

The role of the moderator is to represent " when certain effects will hold" (Baron & Kenny, 1986, pg 1176). If the relationship between exogenous construct and endogenous construct vary due to change in the level of a third variable (moderator), then it suggests the third variable is moderating the relationship between independent and dependent variable (Hair et al., 2017). Five separate models were run to understand the moderating role of environmental uncertainty on the relationship between MCC and cost, quality, delivery, flexibility, and business performance respectively. Firstly, it was hypothesized in H9a that environmental uncertainty positively moderates the relationship between MCC and cost efficiency. The interaction term is positive and significant ($\beta = 0.118$, t value = 2.076, p-value = 0.038). Based on the above results, H9a is supported. Secondly, it was proposed that environmental uncertainty positively moderates the association between MCC and quality. The interaction term is positive ($\beta = 0.079$, t value = 1.698, p-value = 0.090) and significant but the relationship is weak. Accordingly, the results indicate weak support for H9b. Thirdly, H9c stated that environmental uncertainty positively

moderates the relationship between MCC and delivery. The interaction term is positive but not significant (β = 0.066, t value = 1.367, p-value = 0.172). Hence, H9c is not supported. Fourthly, it was hypothesized in H9d that environmental uncertainty positively moderates the relationship between MCC and flexibility. The interaction term is positive and significant (β = 0.102, t value = 2.476, p-value = 0.013). Accordingly, H9d is fully supported. Finally, it was proposed in h9e that environmental uncertainty positively moderates the relationship between MCC and business performance. The results indicate that interaction term is positive and significant. (β = 0.154, t value = 3.124, p-value = 0.002). Based on the above results, H9e is supported. The results of moderation effects are illustrated in table 27.

Table 27 - Moderating Effect of Environmental Uncertainty

Moderation	Dependent Variable	Path Coefficient	T value	P value
MCC*EU	Cost	0.118	2.076	**
MCC*EU	Quality	0.079	1.698	*
MCC*EU	Delivery	0.066	1.367	NS
MCC*EU	Flexibility	0.102	2.476	**
MCC*EU	Business Performance	0.154	3.124	***

MCC- Mass customization capability, EU-Environmental Uncertainty, * P value<0.10, ** P value < 0.05, *** P value <0.01

Simple slop analysis was conducted to understand the moderating effect of environmental uncertainty better. Two-way interaction is shown on the simple slop plot for better interpretation of interaction effects (Hair et al., 2017). In the simple slope plot, the x-axis represents the exogenous construct (MCC in this analysis), and the y-axis represents endogenous construct(cost, quality, delivery, flexibility, and business performance in this analysis. Accordingly, five simple slope plots were drawn, which are illustrated in figure 3,4 5,6 and 7. There are three lines in each plot. The middle line represents the relationship between exogenous variable endogenous

variable at the average level of environmental uncertainty. The middle line (red color) illustrate the association between MCC and the dependent variable at the mean value of environmental uncertainty. The top line (green line) represents the relationship between MCC and the dependent variable at mean value plus one standard deviation unit of environmental uncertainty. The bottom line depicts (blueline) the association between MCC and the dependent variable at mean value minus one standard deviation unit of environmental uncertainty. All the plots have a positive slope. All the five simple slope plot illustrates that higher the environmental uncertainty, MCC has a stronger relationship with the cost, quality, delivery and business performance. The results indicate that when environmental uncertainty is high, the relationship between MCC and delivery is not statistically different at the low and high level of uncertainty.

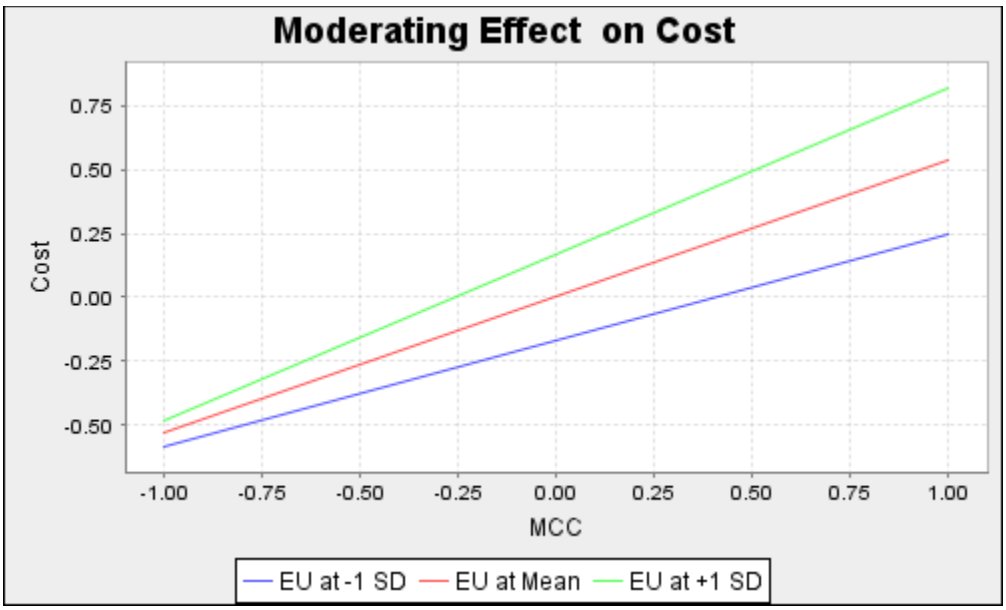

Figure 3- Moderating Effect of Environmental Uncertainty on Cost

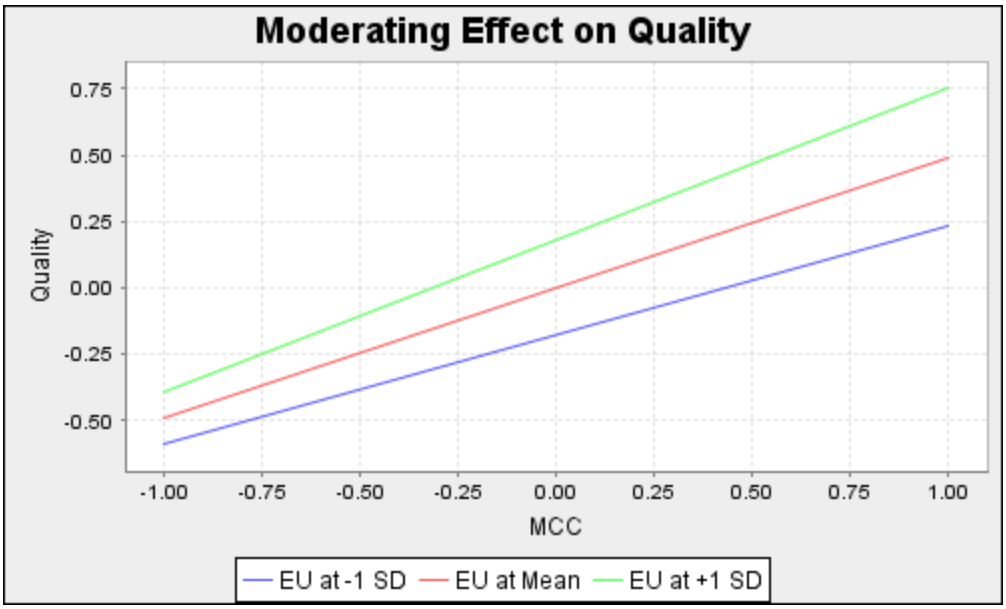

Figure 4- Moderating Effect of Environmental Uncertainty on Quality

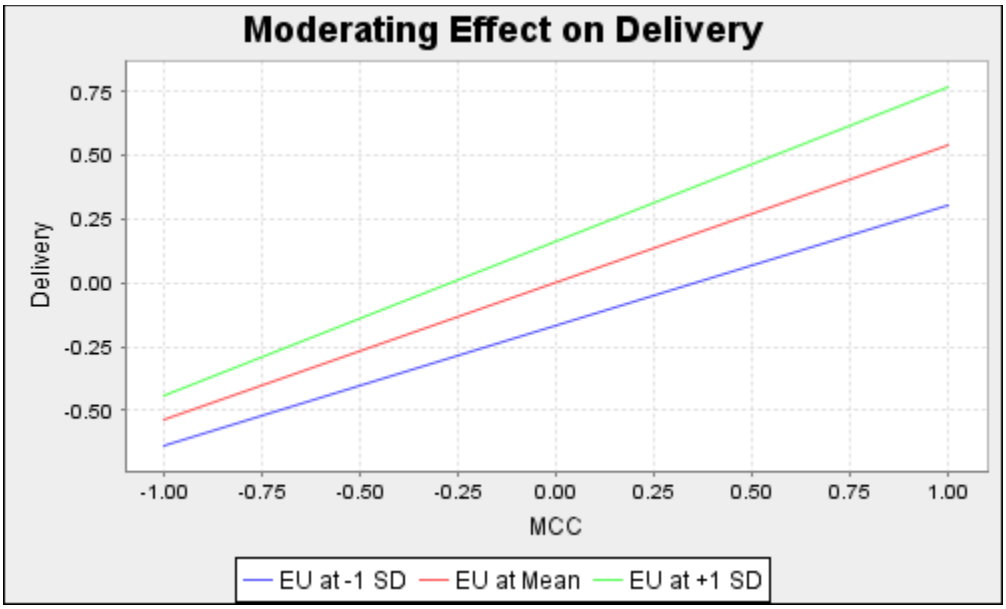

Figure 5- Moderating Effect of Environmental Uncertainty on Delivery

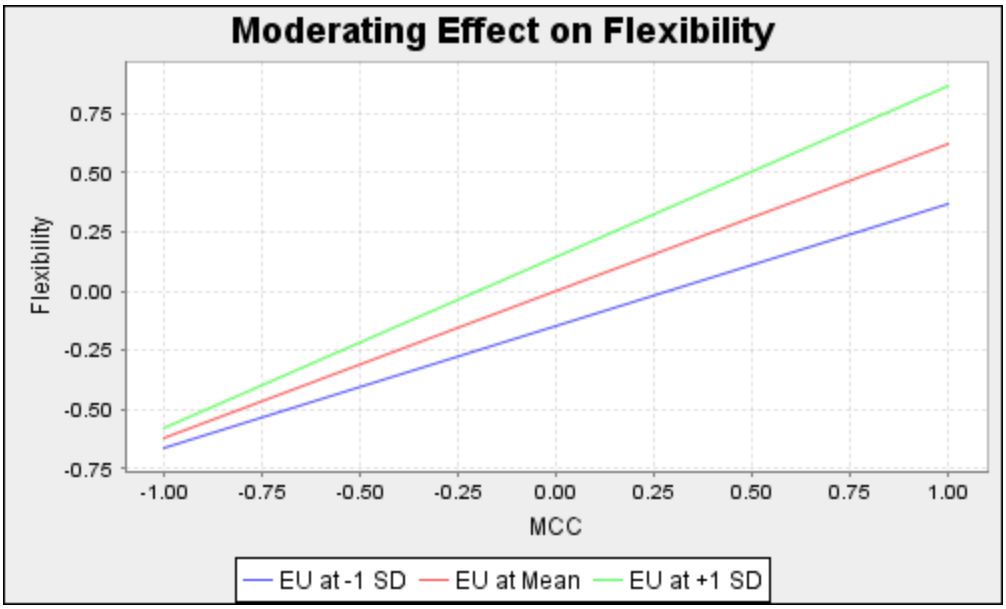

Figure 6- Moderating Effect of Environmental Uncertainty on Flexibility

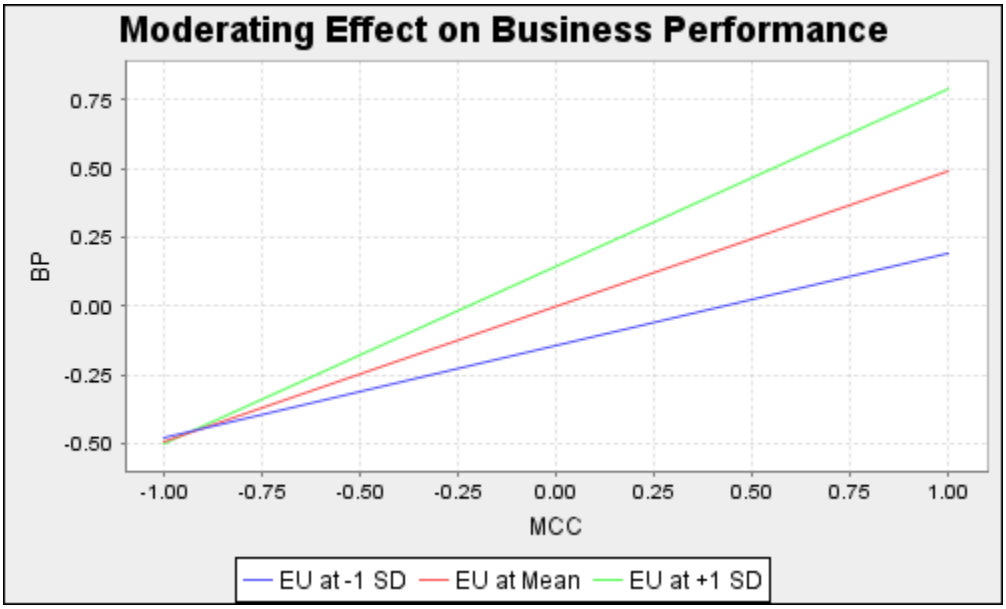

Figure 7- Moderating Effect of Environmental Uncertainty on Business Performance

4.6.4.4 Moderating Effect of Strategic Integration

It was hypothesized in H10 that higher the strategic integration within the firm, stronger the relationship between the firm's agile supply chain strategy and its mass customization

capability. To test this moderation effect, a separate moderation model was run. Size and age were included as control variables in the model. Agile supply chain strategy, strategic integration, and their interaction were linked to mass customization capability and moderation effect was examined. The interaction term is positive and significant (β = 0.140, t value = 3.385, p-value = 0.001). Accordingly, H10 is fully supported. To better understand the results of an interaction effect, simple slope plot was examined as shown in figure 8. The plot demonstrates that as the level of strategic integration increase, the relationship between agile supply chain strategy and mass customization capability become stronger.

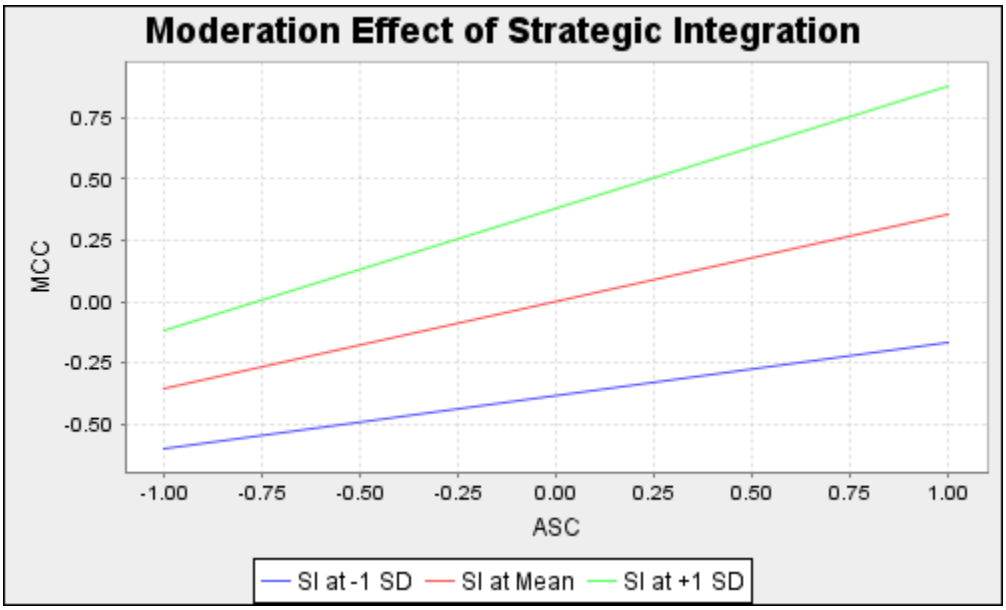

Figure 8- Moderating Effect of Strategic Integration on Mass Customization Capability

4.6.4.5 Main Effect of Model 2

In PLS-SEM, the inner model represents the structural model through which the hypothesized association among the construct is examined (Hair et al., 2014). Smart PLS 3.0 was used to analyze the structural model. Size and age were added as two control variables to control for their effect on operational ambidexterity, cost, quality, delivery, flexibility, and performance. Bootstrapping with 5000 samples approach was used to asses the significance of

the path coefficient. It was proposed in H1 that agile supply chain strategy has a positive association with operational ambidexterity. The results lend support for H1 (β = 0.610, t value = 14.947, p-value = 0.000). H2 -H5 state that operational ambidexterity has a positive relationship with cost, quality, delivery, and flexibility. The results indicate that direct impact of operational ambidexterity on cost (β = 0.0.551, t value = 14.859, p-value = 0.000), quality (β = 0.659, t value = 18.559, p-value = 0.000), delivery (β = 0.6111, t value = 17.433, p-value = 0.000), and flexibility (β = 0.645, t value = 15.508, p-value = 0.000) is positive and significant. Therefore, H2, H3, H4, and H5 are supported. Regarding control variables, age of the firm is negatively related to cost efficiency of the firm (β = -0.089, t value = 2.174, p-value = 0.029). Also, size of the firm has a positive association with operational ambidexterity (β = 0.092, t value = 1.894, p-value = 0.0582), and negative relationship with flexibility (β = -0.0910, t value = 1.964, p-value = 0.049). The standardized path coefficient along with t statistics and p values are shown in table 28.

Table 28- Main Effect of Model 2

Relationship	Path Coefficient	T Statistics	P Values
Age -> Cost	-0.0894	2.174	**
Age -> Delivery	-0.0531	1.4311	NS
Age -> Flexibility	-0.0008	0.0158	NS
Age -> OA	0.0238	0.5333	NS
Age -> Quality	0.0273	0.7046	NS
Size -> Cost	-0.06	1.2029	NS
Size -> Delivery	0.0059	0.1227	NS
Size -> Flexibility	-0.091	1.9643	**
Size -> OA	0.092	1.8944	*
Size -> Quality	-0.0414	0.8773	NS
ASC -> OA	0.6104	14.9469	***
OA -> Cost	0.5511	14.8591	***
OA -> Quality	0.6598	18.5595	***
OA -> Delivery	0.6111	17.4334	***
OA -> Flexibility	0.6455	15.5085	***

OA -Operational Ambidexterity, ASC- Agile Supply Chain Strategy
* P- value <0.10, ** P- value<0.05, *** P-value <0.001 , NS- Not Significant

4.6.4.6 Mediation Effect of Operational Ambidexterity

To test whether operational ambidexterity mediates the association between agile supply chain strategy each of four dimensions of operational performance (cost, quality, delivery, and flexibility), a two-step approach was used to asses the mediation effect as suggested in the literature (Tarafdar & Qrunfleh, 2017). In the first step, the relationship between agility and cost, quality, delivery, and flexibility was investigated. The model was run with 5000 bootstrap sample to test for the significance of the relationships. Also, both age and size were added as control variables in the model to control for the effect of these control variable on each of four dimensions of operational performance.

The results indicate that the impact of agile supply chain strategy on cost (β = 0.464, t value = 10.551), quality (β = 0.451, t value = 8.798), delivery (β = 0.447, t value = 9.381), and flexibility (β = 0.476, t value = 10.174) are positive and significant. In the second step, operational ambidexterity was included in the model as a mediator, and the model was tested for the direct and indirect effect of ASC on all four dimensions of operational performance. The model was rerun with 5000 bootstrapping with 95% confidence level. Also, bias-corrected and accelerated bootstrap confidence interval (95%) approach was used to detect whether zero value is present in the confidence interval (Hair et al., 2017). In the second step, the coefficient of agile supply chain strategy (direct effect) on cost (β = 0.203, t value = 3.503), delivery (β = 0.116, t value = 1.953), and flexibility (β = 0.129, t value = 1.98) were lower in value but all paths were significant. The coefficient of agile supply chain strategy on quality (β = 0.073, t value = 1.225) was positive but not significant. The indirect effect of agile supply chain strategy on cost (β = 0.260, t value = 6.910), quality (β = 0.375, t value = 9.770), delivery (β = 0.329, t value = 8.567), flexibility (β = 0.345, t value = 7.478), and business performance (β = 0.174, t value = 5.268)

was significant. Also, 95% bias-corrected and accelerated (BCa) confidence interval for all four indirect effects did not contain the zero value, thus support the mediation effect. The results of mediation model indicate that operational ambidexterity partially mediates the relationship between agile supply chain strategy and cost, delivery, flexibility. Accordingly, there is partial support for hypotheses H6a, H6c, and Hd. The results also indicate that the impact of agile supply chain strategy on quality is fully mediated by operational ambidexterity. Accordingly, there is full support for H6b. The results of direct and indirect effects are summarized in table 29.

Table 29- Mediation effect of Operational Ambidexterity

Hypothesis	Direct Beta without OA as a mediator	Direct beta with OA as a mediator	Indirect effect (beta)	95% CI of the indirect effect	Type of Mediation
ASC---OA---Cost	0.464 (10.551)***	0.203 (3.503)***	0.260 (6.910)***	0.192-0.342	Partial Mediation
ASC---OA---Quality	0.451 (8.798)***	0.073 (1.225)NS	0.375 (9.770)***	0.302-0.454	Full Mediation
ASC---OA---Delivery	0.447 (9.381)***	0.116 (1.953)*	0.329 (8.567)***	0.257-0.406	Partial Mediation
ASC---OA---Flexibility	0.476 (10.174)***	0.129 (1.982)**	0.345 (7.478)***	0.258-0.439	Partial Mediation

ASC- Agile Supply Chain Strategy, OA- Operational Ambidexterity, * P- value <0.10, ** P - value <0.05, *** P-value <0.001

4.6.4.7 Moderating Effect of Internal Integration

A moderating variable can play two type of roles in the relationship between an exogenous variable and the endogenous variable as suggested by the literature (Baron & Kenny, 1986). First, a moderation is defined as the change in the nature of the relationship between the independent variable and the dependent variable is a function of the moderating variable (Carte & Russell, 2003). Second, the goal of moderation is to assess the variation in the strength of association between an exogenous variable and endogenous variable because of the third variable (Carte & Russell, 2003). In this study, the goal is to assess the change in the strength of the

relationship between operational ambidexterity and each of four operational performance dimensions (cost, quality, delivery, and flexibility) as a function of internal integration. To test the moderating effect of internal integration on the relationship between operational ambidexterity and cost (H7a), quality (H7b), delivery (H7c), and flexibility (H7d), four separate models were run. Firstly, it was hypothesized in H7a that internal integration positively moderates the relationship between operational ambidexterity and cost efficiency. The interaction term is positive and significant ($\beta = 0.105$, t value = 2.518, p-value = 0.011). Based on the above results, H7a is supported. Secondly, it was proposed that internal integration moderates positively the association between operational ambidexterity and quality. The interaction term is negative ($\beta = -0.023$, t value = 0.676, p-value = 0.498) and not significant. Accordingly, the results indicate that H7b is not supported. Thirdly, H7c stated that internal integration positively moderates the relationship between operational ambidexterity and delivery. The interaction term is positive but not significant ($\beta = 0.037$, t value = 0.948, p-value = 0.0.343). Hence, H7c is not supported. Finally, it was hypothesized in H7d that internal integration positively moderates the relationship between operational ambidexterity and flexibility. The interaction term is positive and significant ($\beta = 0.088$, t value = 2.040, p-value = 0.048). Accordingly, H7d is fully supported. The results of moderating effects are summarized in table 30.

Table 30- Moderating Effect of Internal Integration

Moderation	Dependent Variable	Path Coefficient	T value	P value
OA*II	Cost	0.105	2.518	**
OA*II	Quality	-0.023	0.676	NS
OA*II	Delivery	0.037	0.948	NS
OA*II	Flexibility	0.088	2.040	**

OA- Operational Ambidexterity, II-Internal Integration , ** P-value <0.05, NS- Not Significant

To better understand the interpretation of moderation results, two-way interaction by the use of simple slope plot was examined for all the four moderation models as suggested in the literature (Hair et al., 2017). Accordingly, four simple slope plots were drawn, which are shown in figure 9,10,11, and 12. The simple slope plot in figure 9 indicates that higher the internal integration within the firm, the stronger the association between operational ambidexterity and cost efficiency. The analysis of figure 10 suggests that there is no difference in the relationship between operational ambidexterity and quality at lower and higher value of internal integration. Also, the simple slope plot as shown in figure 11 indicates that internal integration does not strengthen the relationship between operational ambidexterity and delivery performance. The analysis of simple slope plot as shown in figure 12 illustrates that higher the internal integration within the firm, the association between operational ambidexterity and flexibility becomes stronger.

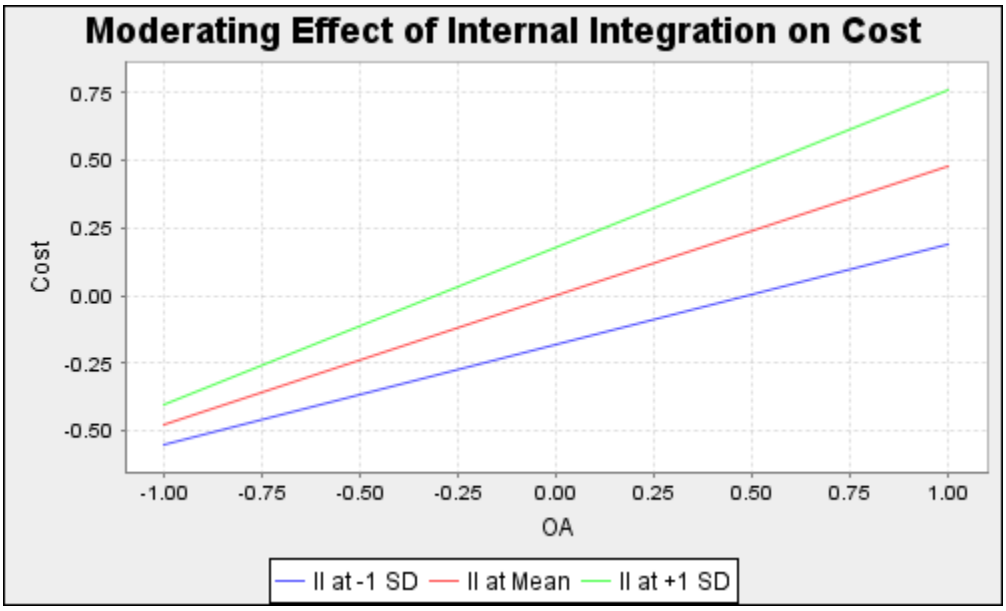

Figure 9- Moderating Effect of Internal Integration on Cost

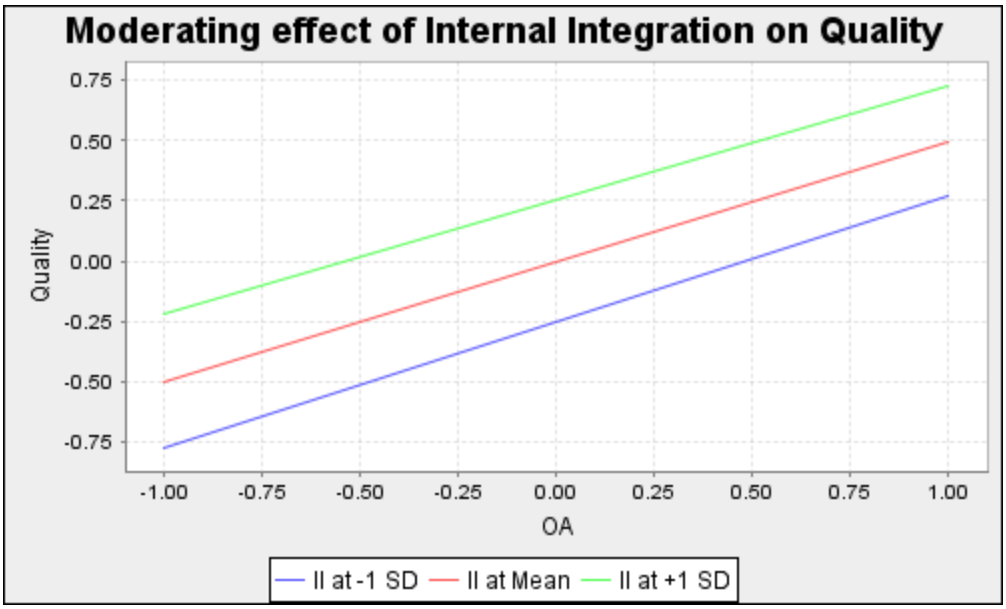

Figure 10- Moderating Effect of Internal Integration on Quality

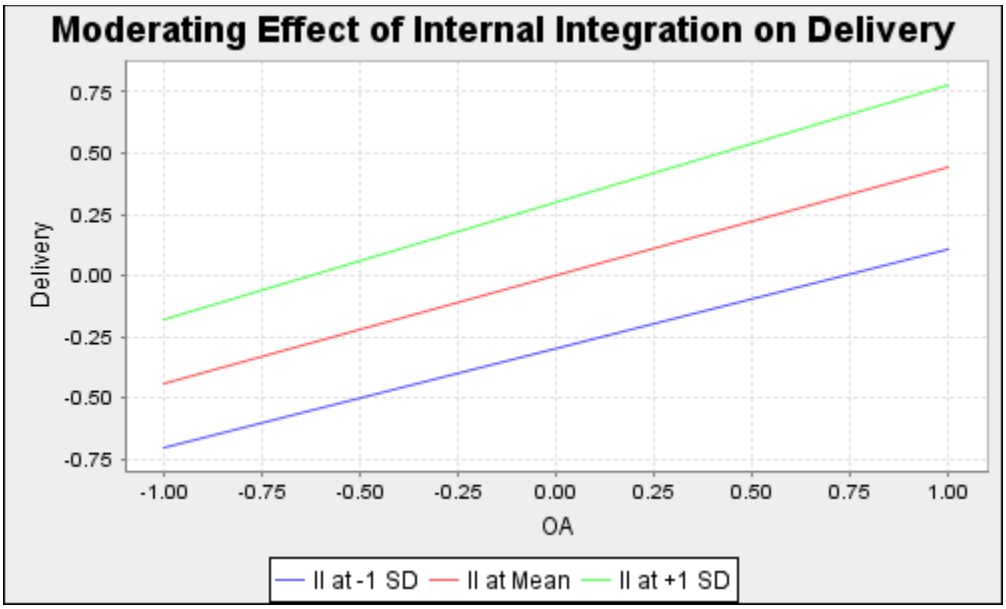

Figure 11- Moderating Effect of Internal Integration on Delivery

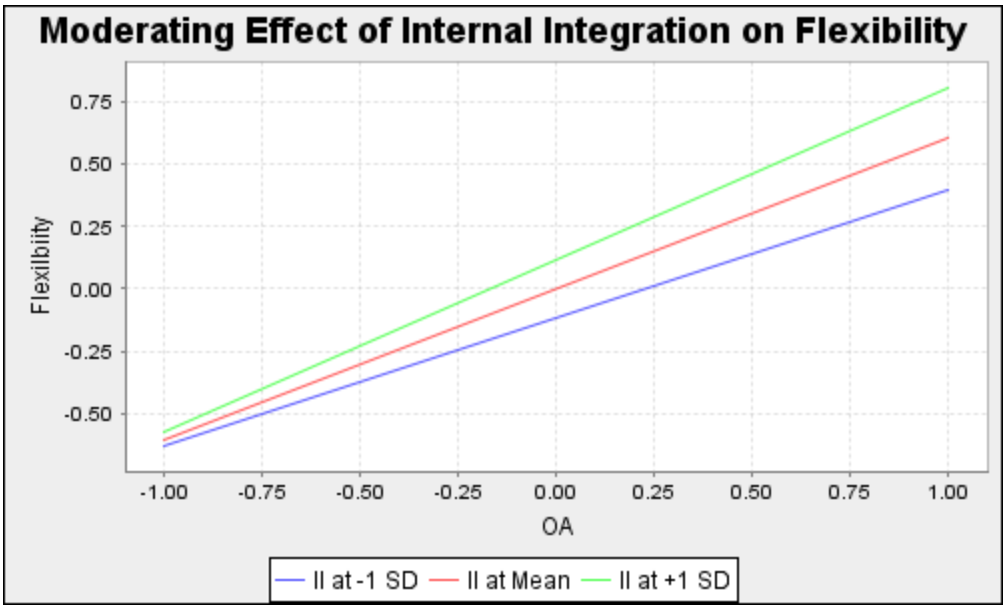

Figure 12- Moderating Effect of Internal Integration on Flexibility

4.6.5 Result Summary of Research Model 1

The results of a theoretical model showing the relationship between agile supply chain strategy, mass customization capability (MCC), strategic integration, environmental uncertainty, cost, quality, delivery, flexibility, and business performance are illustrated in figure 13. The results of control variables are not shown in figure 13 to keep the figure simple. The data supported the majority of hypotheses and the results of hypotheses are summarized in table 31.

Table 31- Result Summary of Research Model 1

Hypothesis	Description	Result
H1	The level of emphasis on an agile supply chain strategy is positively associated to the extent to which MCC is pursued.	Supported
H2	There is a direct and positive relationship between a firm's MCC and the firm's cost performance.	Supported
H3	There is a direct and positive relationship between a firm's MCC and the firm's quality performance.	Supported
H4	There is a direct and positive relationship between a firm's MCC and the firm's delivery performance.	Supported

Table 31- Continued

Hypothesis	Description	Result
H5	There is a direct and positive relationship between a firm's MCC and the firm's flexibility performance.	Supported
H6	There is a direct and positive relationship between a firm's MCC and the firm's business performance.	Supported
H7	Strategic integration of the firm is positively related to mass customization capability (MCC) of the firm.	Supported
H8a	Mass customization capability (MCC) of the firm will mediate the relationship between agile supply chain strategy and cost performance.	Partially Supported
H8b	Mass customization capability (MCC) of the firm will mediate the relationship between agile supply chain strategy and quality performance.	Partially Supported
H8c	Mass customization capability (MCC) of the firm will mediate the relationship between agile supply chain strategy and delivery performance.	Partially Supported
H8d	Mass customization capability (MCC) of the firm will mediate the relationship between agile supply chain strategy and flexibility performance.	Partially Supported
H8e	Mass customization capability of the firm (MCC) will mediate the relationship between agile supply chain strategy and business performance.	Partially Supported
H9a	Environmental uncertainty will moderate the relationship between MCC and cost such that under the high levels of environmental uncertainty, the impact of MCC on cost will be stronger than under the low levels of environmental uncertainty.	Supported
H9b	Environmental uncertainty will moderate the relationship between MCC and quality such that under the high levels of environmental uncertainty, the impact of MCC on quality will be stronger than under the low levels of environmental uncertainty.	Weakly Supported

Table 31- Continued

Hypothesis	Description	Result
H9c	Environmental uncertainty will moderate the relationship between MCC and delivery such that under the high levels of environmental uncertainty, the impact of MCC on delivery will be stronger than under the low levels of environmental uncertainty.	Not Supported
H9d	Environmental Uncertainty will moderate the relationship between MCC and flexibility such that under the high levels of environmental uncertainty, the impact of MCC on flexibility will be stronger than under the low levels of environmental uncertainty.	Supported
H9e	Environmental Uncertainty will moderate the relationship between MCC and business performance such that under the high levels of environmental uncertainty, the impact of MCC on the business performance will be stronger than under the low levels of environmental uncertainty.	Supported
H10	Strategic integration will positively moderate the relationship between agile supply chain strategy and MCC.	Supported

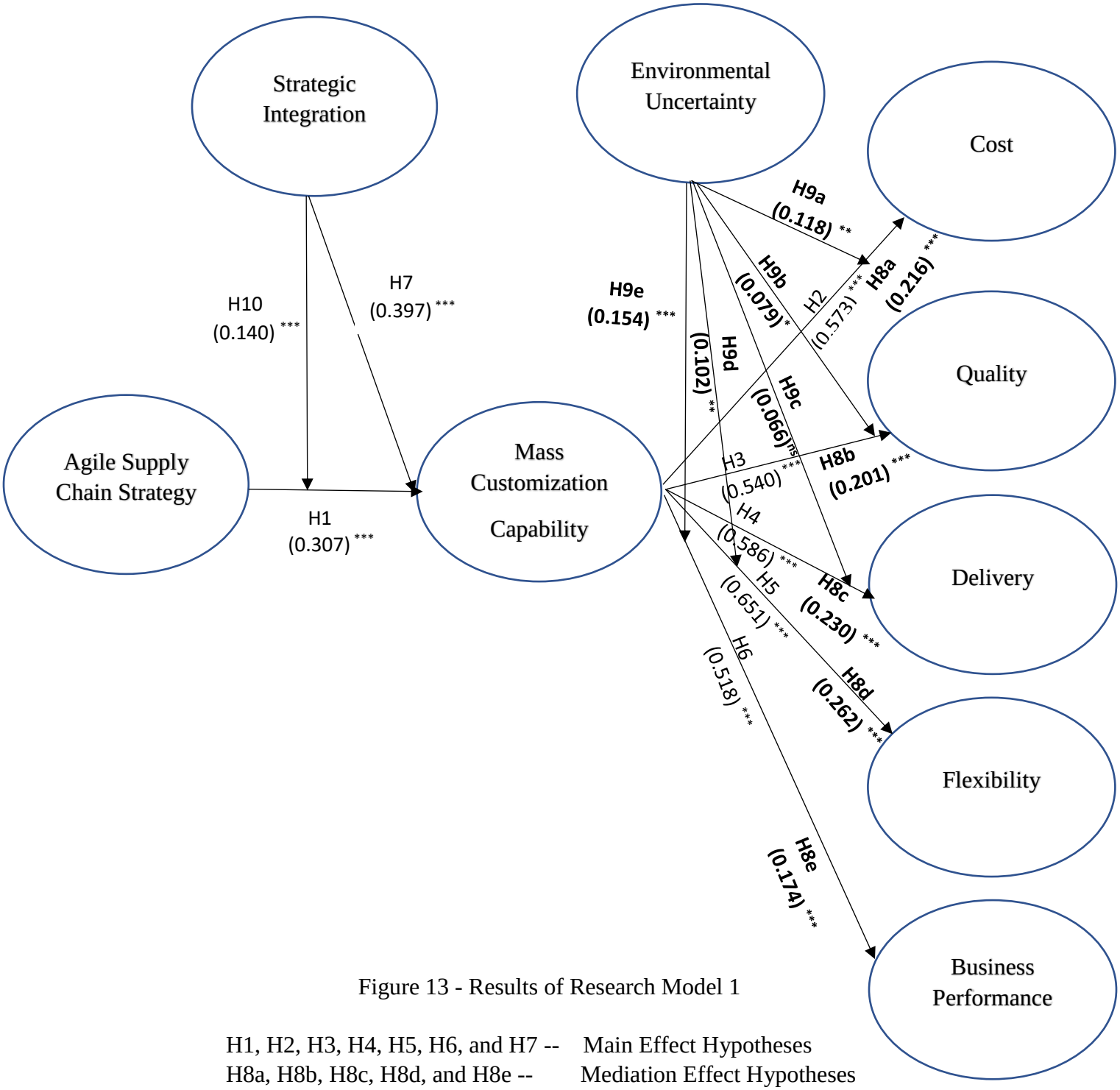

Figure 13 - Results of Research Model 1

H1, H2, H3, H4, H5, H6, and H7 -- Main Effect Hypotheses
H8a, H8b, H8c, H8d, and H8e -- Mediation Effect Hypotheses
H9a, H9b, H9c, H9d, H9e, and H10 -- Moderation Effect Hypotheses

4.6.6 Result Summary of Research Model 2

The results of a theoretical model showing the relationship between agile supply chain strategy, operational ambidexterity, internal integration, cost, quality, delivery and flexibility performance is illustrated in figure 14. The results of control variables are not shown in figure 13 to keep the figure simple. Majority of hypotheses were supported by the data and the results of hypotheses is summarized in table 32.

Table 32- Result Summary of Research Model 2

Hypothesis	Description	Result
H1	The level of emphasis on an agile supply chain strategy is positively associated to the extent to which operational ambidexterity is pursued.	Supported
H2	There is a direct and positive relationship between a firm's operational ambidexterity and the firm's cost performance	Supported
H3	There is a direct and positive relationship between a firm's operational ambidexterity and the firm's quality performance	Supported
H4	There is a direct and positive relationship between a firm's operational ambidexterity and the firm's delivery performance	Supported
H5	There is a direct and positive relationship between a firm's operational ambidexterity and the firm's flexibility performance	Supported
H6a	Operational Ambidexterity of the firm will mediate the relationship between agile supply chain strategy and cost performance	Partially Supported
H6b	Operational Ambidexterity of the firm will mediate the relationship between agile supply chain strategy and quality performance	Supported
H6c	Operational Ambidexterity of the firm will mediate the relationship between agile supply chain strategy and delivery performance	Partially Supported
H6d	Operational Ambidexterity of the firm will mediate the relationship between agile supply chain strategy and flexibility performance	Partially Supported

Table 32-Continued

H7a	Internal Integration will moderate the relationship between operational ambidexterity and cost performance such that impact of operational ambidexterity on cost performance will higher at a high level of internal integration than at the low level of internal integration.	Supported
H7b	Internal Integration will moderate the relationship between operational ambidexterity and quality performance such that impact of operational ambidexterity on quality performance will higher at a high level of internal integration than at the low level of internal integration.	Not Supported
H7c	Internal Integration will moderate the relationship between operational ambidexterity and delivery performance such that impact of operational ambidexterity on delivery performance will higher at a high level of internal integration than at the low level of internal integration.	Not Supported
H7d	Internal Integration will moderate the relationship between operational ambidexterity and flexibility performance such that impact of operational ambidexterity on flexibility performance will higher at a high level of internal integration than at the low level of internal integration.	Supported

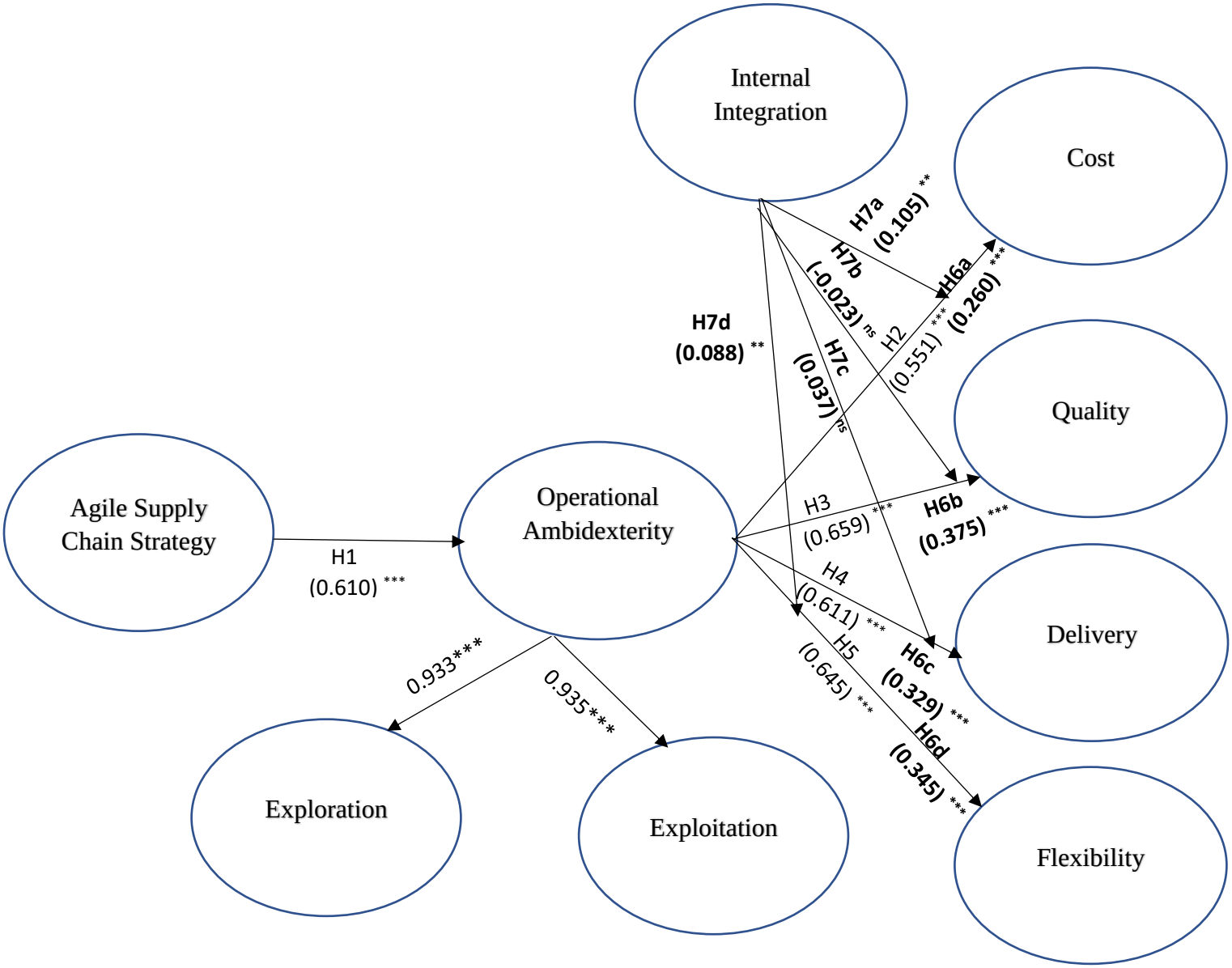

Figure 14 - Results of Research Model 2
H1, H2, H3, H4, and H5 -- Main Effect Hypotheses
H6a, H6b, H8c, and 6d -- Mediation Effect Hypotheses
H7a, H7b, H7c, and H7d -- Moderation Effect Hypotheses

Chapter 5

5.1 Discussion

Two research models are examined in this research with the following objectives. First, the objective of this research was to investigate the relationship between agile supply chain strategy and two operational capabilities (mass customization capability (MCC) and operational ambidexterity (OA)). Second, the goal was to assess the impact of MCC and OA on multiple dimensions of operational performance, and business performance in this study. Third, the goal was to examine the mediating role of MCC and OA to find answers to the question: how agile supply chain strategy influences the firm performance?. Fourth, the objective was to investigate the moderating role of strategic integration and environmental uncertainty to understand the strength of the relationship between agile supply chain strategy and MCC, and MCC and multiple dimensions of performance respectively. Finally, the goal was to examine the moderating role of internal integration to understand the mechanism that can boost the relationship between OA and multiple measures of operational performance.

The results in model 1 and model 2 support the argument that an agile supply chain strategy has a positive relationship with both MCC and OA. Prater et al., (2001) argued that firms have to deal with challenges to become agile. The results of this study indicate that the development of MCC and OA are two capabilities that can enable the firm to become agile. The finding of this study suggests that the firm pursuing agile supply chain strategy should devote resources to develop MCC and OA.

Regarding value creation by MCC, the results demonstrate a positive effect of MCC on cost, quality, delivery, flexibility and business performance. Also, the impact of OA on all four

dimensions of operational performance (cost, quality, delivery, and flexibility) was positive. These results indicate the organization can compete on multiple dimensions of performance through the development of MCC and OA as suggested by the cumulative model (Ferdows & De Meyer, 1990). The cumulative model or ‘ sand cone model’ prescribes that improvement in one performance dimension facilitate the enhancement in another performance dimension (Ferdows & De Meyer, 1990). They also argued that performance as a result of the cumulative model is sustainable in the long run. The results demonstrate that rather than competing on narrow competitive dimensions, firms can compete on cost, quality, delivery and flexibility dimensions simultaneously.

This study also argued that MCC mediates the relationship between agile supply chain strategy and cost, quality, delivery, flexibility, and business performance (H8a-H8e in research model 1). The results indicate a partial mediation for all the five hypotheses. In research model 2, it was proposed that OA will mediate the relationship between agile supply chain strategy and cost, quality, delivery, and flexibility (H6a-H6d). The study found that OA partially mediates the relationship between agile supply chain strategy and cost, delivery, and flexibility. Also, the results indicate OA fully mediates the relationship between agile supply chain strategy and quality. Overall, both the research model suggests that MCC and OA are two means through the firms can realize the goal of agile supply chain strategy.

It was hypothesized that strategic integration acts as an enabler of MCC. The finding indicates that knowledge creation through strategic integration allows the firms the firm to alter their resources to develop the operational capability. Also, it was proposed that higher the strategic integration, stronger the relationship between agile supply chain strategy and MCC (H10). The result indicates that strategic integration is a complementary asset that helps the

organization to work in cohesion and that helps the organization to fulfill the objective of its supply chain strategy by facilitating the development of appropriate capability.

Although the beneficial impact of MCC and OA has been recognized in the literature, there is a lack of understanding of the context to explain the variation in the MCC and performance relationship or variation in OA and performance association. The results (H9a – H9e) of research model 1 indicate the importance of environmental uncertainty. The results indicate that higher the environmental uncertainty, stronger the relationship between MCC and cost, quality, flexibility, and business performance. However, this study did not find the support for H9c that there is no difference in the strength of the relationship between MCC and delivery at the low and high value of environmental uncertainty. These results support MCC literature which argues that MCC allows the firm to achieve the external fit (Huang et al., 2008).

In research model 2, it was argued that the relationship between OA and cost, quality, delivery, and performance would be augmented due to a higher level of internal integration within the firm (H7a-H7d). The results are mixed. The results provide evidence that higher the internal integration, the impact of operational ambidexterity on cost, and flexibility become stronger, thereby confirming the importance of internal integration (Flynn et al., 2010). However, the results did not support the argument that internal integration will enhance the impact of OA on quality, and delivery. The sand cone model can explain the nonsignificance of these results. According to Ferdows & Meyer (1990), the firms first improve quality, then delivery and followed by an improvement in flexibility and cost. Most of the firms in the sample of this study have been operating for more than twenty years. It might be the case, these firms already have developed a threshold level of quality and delivery and the firms focus more on cost and flexibility during interaction among employees within the organization.

5.2 Research Implications

This research contributes to theory in the following ways. The literature has argued that operations management researchers should study capability rather than practice perspective (Su et al., 2014). Accordingly, this study contributes to theory by examining the agile supply chain strategy from the capability perspective. Specifically, this research argued conceptually and provided empirical evidence that firms pursuing agile supply chain strategy use their resources to develop MCC and OA. Fogliatto et al., (2012) in their review of MCC suggested that future research should examine the relationship between supply chain strategy and MCC. Accordingly, this study adds to MCC body of knowledge by showing empirically that there is a positive relationship between agile supply chain strategy and MCC. This research contributes to the literature of ambidexterity by examining the OA from the operations and supply chain management perspective as suggested by the previous studies (Andriopoulos & Lewis, 2009; Patel et al., 2012).

Previous studies have mixed result related to agile supply chain strategy and performance and scholars have called for additional research to understand how agile supply chain strategy influences the firm performance (Gligor, 2016; Gligor et al., 2015). This research answers these calls by providing empirical evidence that MCC and OA mediate the relationship between agile supply chain strategy and performance. In other words, MCC and OA are two means through which the goal of the agile supply chain are translated into performance outcomes such as cost, quality, delivery, flexibility, and business performance. Just deciding to pursue agile supply chain strategy is not sufficient, the firms need to develop capabilities to support the objective of agile supply chain strategy.

Scholars have urged that future researcher to examine the contextual factors to understand the conditions under which a practice or capability is effective (Sousa & Voss, 2008). In this study, environmental uncertainty was used as external environmental context, and it was found that higher the environmental uncertainty, the impact of MCC on cost, quality, flexibility and business performance become stronger but not on delivery. This study also contributes to supply chain integration and ambidexterity literature by providing empirical evidence that internal integration is knowledge creation and knowledge combining mechanism by which the firm can reap more benefit out of OA because internal integration amplifies the impact of OA on cost and flexibility. This study also contributes to the strategic perspective of supply chain integration by demonstrating that strategic integration acts as an antecedent to the development of MCC and as well as acts as a facilitator between agile supply chain strategy and MCC.

5.3 Practitioners Implications

The results of this research provide valuable insights for the practitioners. The results indicate that firms pursuing agile supply chain strategy develop MCC and OA capabilities. Managers need to devote and direct their scarce resources to facilitate the development of these two operational capabilities. Deloitte's survey indicates that focusing on cost efficiency has made the firm's supply chain weaker and these executives emphasize that agility is the key ingredient to be successful (Deloitte, 2014). The results of this study also indicate that agile supply chain strategy can help the firms achieve better performance cost, quality, delivery, flexibility, business performance simultaneously, thereby providing the evidence of value creation by the implementation of agile supply chain strategy.

To compete on all dimensions of performance, managers should focus on developing MCC and OA because the results indicate the MCC and OA are two pathways through which

firms can achieve the objective of their supply chain strategy. The results of this study highlight the importance of strategic integration. In a survey by Mckinsey & Company (Mckinsey Global Survey, 2010), the majority of senior executives pointed out that lack of collaboration is a hindrance to better performance. This study highlights the importance of strategic integration and managers need to develop a mechanism for effective communication of the strategy within the organization such as notice board displaying information and formal and informal meeting to create a common language (Swink et al., 2005) so that it allows all members of the organization to achieve the goal of its strategy.

In a survey done by Mckinsey & company (Mckinsey Global Survey, 2010), senior executives acknowledged the importance of higher performance both on efficiency and effectiveness. The results of this study indicate that the development of MCC and OA are two enablers that can allow the firm to improve on both the front: efficiency and effectiveness.

This study also provides insights to the manager regarding the conditions under which the impact of MCC and OA on performance become stronger. For instance, this study informs the practitioners that when environmental uncertainty is high, the impact of MCC on cost, quality, flexibility, delivery, and business performance becomes more prominent. These results can be used by the managers to justify their demand for more resources to develop MCC and OA. The supply chain professionals are often upset about how to utilize the information to improve the performance (Williams et al., 2013). The results of this study indicate that firms need to develop processes for functional coordination within the firm in order to cultivate the knowledge created by operational capabilities (OA).

5.4 Limitations and Future Directions

This research contributes to both theory and practice, but this research is not without limitations which is the case with the cross-sectional studies. One of the limitations of this study is the age of the firm. Majority of firms in this study are operational for more than twenty years. Accordingly, the results cannot be generalized to newer firms. The design of the study was cross-sectional, so it is difficult to make a causal claim about the relationships among constructs in this study. The data was collected from the manufacturing firms operating in the United States. Hence, the results can not be generalized to other countries or the service industry. The focus of this study was on agile supply chain strategy, and this study did not address the capabilities and outcomes associated with lean supply chain strategy. This study controlled for the variables such as size and age that might influence the results, however, there are other variables such as technology which might influence the relationship studied in this research.

The study of supply chain management from a strategic perspective is at a nascent stage (Qi et al., 2009), which provides plenty of opportunities for future research. This study examines the relationship between agile supply chain strategy and two operational capability (MCC and OA). There are other operational capabilities such as process alignment and partnering flexibility. Process alignment is referred to efficiency in the process by working with the suppliers of the firm and partnering flexibility refers to the ability of the firm to alter its supply side (Rai & Tang, 2010). It will be worthwhile to examine both lean and agile supply chain strategy, and these two suppliers focused operational capabilities. Previous studies have examined the role of the information technology(Qrunfleh & Tarafdar, 2014) and supply chain uncertainty(Qi et al.,2011) within the supply chain context. Future research with the supply chain strategy domain should consider the relationship between supply chain strategy and other

strategies such as quality strategy. For instance, Zhang et al., (2012) argued that different quality practices are geared toward different orientation such as control or innovation. Similarly, the lean and agile supply chain firms have a different orientation. Hence it is important to understand the relationship between a firm's supply chain strategy and quality strategy. Although researchers have highlighted the importance of the role of human resource with supply chain strategy ((Vonderembse et al., 2006), no study has investigated the role of human resource in the field of supply chain strategy. Accordingly, future research should consider this infrastructural element within the supply chain strategy.

5.5 Conclusion

This study advances the understanding of agile supply chain strategy through theory development and empirical examination of the relationship between agile supply chain strategy, MCC and OA, and their association with multiple operational performance dimensions and business performance. Also, this study investigated the role on the internal environment (strategic integration and internal integration), and external environment (environmental uncertainty) to better understand the condition under which the relationship among agile supply chain strategy, operational capabilities (MCC and OA), and performance are strengthened.

Drawing from the theoretical perspective of strategy- structure- performance (SSP), knowledge-based view (KBV), and contingency theory (CT), this study attempted to explain (a) what capabilities firm should develop to support the agile supply chain strategy, (b) how MCC and OA enables the firms in realizing the goal of their supply chain strategy, (c) the context (environmental uncertainty and internal integration) under which the association between operational capabilities (MCC and OA) and performance is enhanced, and (d) the role of strategic integration to augment the relationship between agile supply chain strategy and MCC.

Although this study expands the prior research in the supply chain strategy domain, more research is needed to understand the means and consequences of agile supply chain strategy.

APPENDIX A

SURVEY

On behalf of the University of Texas at Arlington, thank you for taking the time to complete this survey. The purpose of this study is to better understand the relationship between strategy and capabilities of a firm and their impact on the value creation. The information obtained from the study will be stored securely and shall be used and made available only to those persons involved in this research. This survey will not retain any identifying information. All questions in this survey are for research purposes only and will only be reported in aggregate, so please respond as candidly as possible.

Your participation is completely voluntary. We know of no risks to your participation. Completion of the survey will take about 15 minutes. If you have any questions about this study, please contact Kuldeep Singh at ksingh@uta.edu, or at 817-272-3562.

By clicking "ACCEPT" below, you confirm that you are 18 years of age or older and have read or had this document read to you. You have been informed about this study's purpose, procedures, possible benefits and risks, and you may print a copy of this form using the "Print" function in your browser. You voluntarily agree to participate in this study. By clicking "ACCEPT" below, you are not waiving any of your legal rights. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled.

- ○ ACCEPT; I voluntarily agree to participate in this study.
- ○ DECLINE; I do not wish to participate in this study.

Q1. We care about the quality of our data. In order for us to get the most accurate measures of your opinions, it is important that you thoughtfully provide your best answers to each question in his survey. Do you commit to thoughtfully provide your best answers to each question in this survey?

- ○ I commit to giving my best answers
- ○ I don't commit to giving my best answers
- ○ I can't commit either way

Q2.1 Which country do you live in?

- ○ China
- ○ Brazil
- ○ Russia
- ○ US
- ○ Others

Q2.2 Do you work in a manufacturing industry?

- ○ Yes
- ○ No

Q2.3 Please choose the option which best describes your work area?

- ○ Information system
- ○ Supply chain
- ○ Accounting
- ○ Procurement
- ○ Finance
- ○ Production
- ○ Quality Management

- ○ Logistics

Q2.4 How long you have been working at your current company?

- ○ < 1 year
- ○ 1-3 years
- ○ 3-5 years
- ○ 5-10 years
- ○ 10-15 years
- ○ 15-20 years
- ○ > 20 years

Q2.5 Please indicate your level of professional work experience

- ○ < 1 year
- ○ 1-3 years
- ○ 3-5 years
- ○ 5-10 years
- ○ 10-15 years
- ○ 15-20 years
- ○ > 20 years

Q2.6 What is the approximate number of employees in your organization?

- ○ <100
- ○ 100-500
- ○ 501 - 1,000
- ○ 1,001 - 5,000
- ○ 5,000 - 10,000
- ○ 10,000 or more

Q2.7 Which of the following most accurately describes your level of responsibility?

- ○ Shop floor/ warehouse Worker
- ○ Professional or degreed individual contributor
- ○ Middle Manager
- ○ Senior management or Executive

INSTRUCTIONS: This survey is designed to understand the various elements of a firm's supply chain that help the firm to compete in an industry. Please consider the following as you respond to the survey. 1.A firm can participate in various supply chains. For this study, **please consider the supply chain of your firm's main product line.**

2.The main product line is defined as the group of related products that account for the most portion of your firm's total sales/revenue.

3. **Warning: Make sure to read the questions and their options carefully as the survey is designed to screen out participants who do not pay close attention while answering the questions.**

4. Please click on Next button after reading the instructions to start the survey.

Q3. This section of survey deals with a firm's supply chain strategy. The supply chain strategy of the firm reflects the goals and objectives that apply to its supply chain. Please consider the main product line of your firm while answering these questions.
For your firm's supply chain, how important it is to:

	Not at all important	Low importance	Slightly important	Of Average Importance	Moderately Important	Very Important	Absolutely Essential
Respond effectively to changing requirements of design.	○	○	○	○	○	○	○
Respond quickly to customization requirements.	○	○	○	○	○	○	○
Handle changes in product design.	○	○	○	○	○	○	○
Maintain a higher capacity buffer to response to a volatile market.	○	○	○	○	○	○	○
Select suppliers based on their performance on flexibility.	○	○	○	○	○	○	○
Select suppliers based on their performance on responsiveness.	○	○	○	○	○	○	○
Provide customers with personalized products.	○	○	○	○	○	○	○

Q4 Please evaluate your firm's performance in the following areas relative to your major competitors.

	Much worse	Moderately worse	Slightly worse	About the same	Slightly better	Moderately better	Much better
Return on Investment (ROI).	○	○	○	○	○	○	○
Return on Assets (ROA).	○	○	○	○	○	○	○
Return on Sales (ROS).	○	○	○	○	○	○	○
Market share.	○	○	○	○	○	○	○
Growth in market share.	○	○	○	○	○	○	○
Growth in sales.	○	○	○	○	○	○	○
Growth in return on investment (ROI).	○	○	○	○	○	○	○
Growth in return on asset (ROA).	○	○	○	○	○	○	○
Growth in profit.	○	○	○	○	○	○	○

Q5. Listed below are the critical success factors for competing in an industry. Please indicate your assessment of the strength of your firm for each capability relative to your competitors. Please think of your firm's main product line while answering these questions.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
We are highly capable of large-scale product customization.	○	○	○	○	○	○	○
We can easily add significant product variety without increasing costs.	○	○	○	○	○	○	○
Our set up costs, when changing from one product to another, are very low.	○	○	○	○	○	○	○
We can customize products while maintaining high volume.	○	○	○	○	○	○	○
We can add product variety without sacrificing quality.	○	○	○	○	○	○	○

Q6. Listed below are the critical success factors for competing in an industry. Please indicate your assessment of the strength of your firm for each capability relative to your competitors. Please think of your firm's main product line while answering these questions.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Our organizations respond to demands that go beyond our existing products and services.	○	○	○	○	○	○	○
We always look for creative ways to satisfy our customer's needs.	○	○	○	○	○	○	○
We actively seek new manufacturing technologies and systems.	○	○	○	○	○	○	○
We look for novel operational technological ideas by thinking "outside the box".	○	○	○	○	○	○	○
Our success depends on our abilities to explore new operational technologies.	○	○	○	○	○	○	○
We aggressively venture into new product segments.	○	○	○	○	○	○	○

Q7. Listed below are the critical success factors for competing in an industry. Please indicate the extent to which you agree or disagree with the following statements regarding your firm. Please think of your firm's main product line while answering these questions.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
We frequently make small adjustment to our existing products and services.	○	○	○	○	○	○	○
We continuously improve production efficiency of our products and services.	○	○	○	○	○	○	○
We continuously improve the reliability of our product and services.	○	○	○	○	○	○	○
We fine-tune operational activities to keep our current customers satisfied.	○	○	○	○	○	○	○
We increase the levels of automation in our operations.	○	○	○	○	○	○	○
Our firm commits to improve quality and lower cost.	○	○	○	○	○	○	○

Q8. The following set of questions deals with the integration practices that are followed by a firm. Please indicate the extent to which you agree or disagree with the following statements regarding your firm.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Our firm's supply chain strategy is well aligned with the corporate strategy.	○	○	○	○	○	○	○
Our supply chain strategic goals and objectives are clearly defined.	○	○	○	○	○	○	○
Supply chain strategies and goals are communicated to all employees.	○	○	○	○	○	○	○
Our firm's strategic goals leverage our company's existing capabilities.	○	○	○	○	○	○	○
Supply chain strategy is frequently reviewed and revised.	○	○	○	○	○	○	○

Q9. This section of the survey is related to business environment factors. Please indicate the extent to which you agree or disagree with each of these statements about your firm’s business environment.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The rate at which products and services become outdated in our industry is extremely high.	○	○	○	○	○	○	○
The rate of innovation of new products and services in our industry is extremely high.	○	○	○	○	○	○	○
The demand for our firm's products is unstable and unpredictable.	○	○	○	○	○	○	○
The rate of innovation of new operating processes is extremely high.	○	○	○	○	○	○	○

Q10. Please indicate the extent to which agree or disagree with the following statements regarding your firm.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
We have a high level of responsiveness with in our firm to meet other department's need.	○	○	○	○	○	○	○
We have integrated information system across functional areas.	○	○	○	○	○	○	○
In our firm, we have periodic interdepartmental meetings among internal function.	○	○	○	○	○	○	○
Internal functional teams (e.g. operations, purchasing, logistics, sales, marketing, finance, engineering, quality, information technology) work together to accomplish supply chain planning and execution.	○	○	○	○	○	○	○
Planning decisions are based on plans agreed upon by all functional teams.	○	○	○	○	○	○	○
Operational and tactical information is regularly exchanged between functional teams.	○	○	○	○	○	○	○
Functional teams are aware of each other's responsibility.	○	○	○	○	○	○	○

Q11. Please evaluate your firm's performance in the following areas relative to your major competitors.

	Much worse	Moderately worse	Slightly worse	About the same	Slightly better	Moderately better	Much better
Produce products with low costs.	○	○	○	○	○	○	○
Produce products with low inventory costs.	○	○	○	○	○	○	○
Produce products with low overhead costs.	○	○	○	○	○	○	○
Offer price as low or lower than our competitors.	○	○	○	○	○	○	○
Order -to- delivery cycle time.	○	○	○	○	○	○	○
Order-to-delivery cycle time consistency.	○	○	○	○	○	○	○
Correct quantity with right kind of products	○	○	○	○	○	○	○
On time deliveries.	○	○	○	○	○	○	○
Conformance to product specification.	○	○	○	○	○	○	○
Reliability of the products.	○	○	○	○	○	○	○
Durability of products.	○	○	○	○	○	○	○
Quality of the products.	○	○	○	○	○	○	○

	Much worse	Moderately worse	Slightly worse	About the same	Slightly better	Moderately better	Much better
Satisfaction of customers with the quality of our products	○	○	○	○	○	○	○
Product capability and performance.	○	○	○	○	○	○	○
Speed of new product introduction (development lead time).	○	○	○	○	○	○	○
Offer a large number of product features.	○	○	○	○	○	○	○
Offer a large degree of product variety.	○	○	○	○	○	○	○
Adjust product mix.	○	○	○	○	○	○	○
Develop new product features to our customers.	○	○	○	○	○	○	○
Change product offered to meet customers' needs.	○	○	○	○	○	○	○

Q12. This part of survey deals with the information that will help the research team understand differences in various business settings. Which term best describes your industry? Please check all that apply.

- ○ Automotive
- ○ Medical/Pharmaceutical
- ○ Apparel/textiles
- ○ Electronics
- ○ Industrial Products
- ○ Consumer packaged goods
- ○ Chemicals/plastics
- ○ Appliances
- ○ Others _____

Q13. What is the approximate annual sales revenue (in US dollars) of your firm?

- ○ < 1 million
- ○ 1- 50 million
- ○ 51- 500 million
- ○ 501 million- 1 billion
- ○ 1.1- 5 billion
- ○ 5.1- 10 billion
- ○ > 10 billion

Q14. Please indicate your level of education:

- ○ High School
- ○ Some college
- ○ College Graduate/ bachelor's Degree
- ○ Masters/ MBA
- ○ PHD
- ○ Others _____

Q15. Approximately, how long has your organization been in business (in years)?

- ○ <1 years
- ○ 1-5 years
- ○ 5- 10 years
- ○ 10-15 years
- ○ 15-20 years
- ○ >20 years

Q16. Please indicate your current job title:

_____

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